VOL. III, PART 1. QUARTERLY. OCTOBER, 1915.

THE JOURNAL OF DAIRYING

AND

DAIRY FARMING IN INDIA

DAIRY EDUCATION ASSOCIATION

D. E. A

Printed by Thacker, Spink & Company, 6, Mangoe Lane, Calcutta, and
Published for the Committee, Dairy Education Association in India

CONTENTS.

THE
JOURNAL OF DAIRYING
and
Dairy Farming in India.

VOL. III.—PART 1.] QUARTERLY [OCTOBER, 1915.

EDITORIAL.

REFERRING to the editorial in the last issue, the Sub-Committee are gratified with the response made, in fact several new members have been proposed and the concensus of opinion makes it clear that we should in future charge Rs. 4/ subscription for the Journal instead of Rs. 2, which alteration the Sub-Committee have now made for Vol. III.

***

It is also suggested that we should approach the Home Committee asking them to reduce our subscriptions from 2*s*. 6*d*. to one shilling on full members. The Committee are being addressed.

Others have suggested that the subscriptions for members be raised to Rs. 5 instead of Rs. 3/12. But the Sub-Committee would like further opinions on this from members. Members are therefore asked to write to the Hony. Secretary at once if they have any objection. If they do not write it will be considered that they approve.

***

Some members have proposed that the various Governments be asked to give a subsidy. Our policy is "self help," and we do not advocate Government assistance to every enterprise. Until this idea, *viz.*, "Government assistance to every new idea," is put a stop to, India can never advance. Private enterprise that must be bolstered up is of no use in the business world, and it were better they never existed.

BACTERIOLOGICAL EXAMINATION OF THE BOMBAY MILK SUPPLY AND THE QUESTION OF BACTERIAL STANDARDS FOR INDIA.

BY

DR. LEMUEL LUCAS JOSHI, M.D., B.SC., D.T.M., F.C.S.

CHEMICAL analysis of milk enables us to find out whether the milk is *pure*, or whether there is any adulteration with water, etc., but does not reveal anything as regards the contamination of milk with dirt, microbes of disease, etc. A sample of milk may be quite genuine chemically, but may be grossly contaminated with filth and even with dangerous bacteria. The public milk-supply must be both *pure* from a chemical point, and *clean* from a bacterial point, of view. It should be entirely free from contamination with the specific bacilli of the Acute Infectious Diseases, *e.g.*, Tuberculosis, Typhoid, Diphtheria, etc. It should be also reasonably free from cow-dung, stable refuse, and other objectionable pollutions. *Bacteriological Examination of Milk is, therefore, very important from a sanitary point of view.*

Sources of Bacteria in Milk.—Most observers assume that milk as secreted in the healthy udder is entirely free from bacteria. This has been disputed by others. Under suitable conditions, and with strict sanitary precautions, it is quite possible to obtain bacteria-free milk at least in small quantities. The writer has been able to get perfectly sterile samples on several occasions in Bombay. S. L. Stewart of Brookside Farms, Newburgh, New York, has been able to

produce milk in large quantities almost free of bacteria. If milk in the udder is sterile, where do the bacteria come from? Bacteria may squirm up the milk ducts and work their way into the milk cistern. Once there, they find ideal conditions for rapid growth—a warm, cozy dark home, with an abundance of food. This may account for the initial contamination of milk. It must be also remembered that the virus of Foot-and-Mouth Disease, which is ultra-microscopic, and the virus of "Milk Sickness" and the micrococcus causing Malta Fever are found in the milk of affected animals, even though the udder may not be diseased. Bacteria may have their origin in mastitis and other diseases of the udder. Ordinarily, the real contamination occurs after the milk has left the udder.

From the act of milking to the final distribution and consumption of milk, numerous and varied are the possibilities of contamination. Seventeen sources are mentioned below. *During the process of milking* the possible sources are from

(1) the calf which in India is usually allowed to have the first start in getting its share of milk from the mother;

(2) the dirty udders and flanks of the unwashed animal;

(3) the unwashed hands of the milker;

(4) the filthy clothing which the average milkman wears in India;

(5) the insanitary habits of the milkman, *e.g.*, coughing, sneezing, nose-blowing with the fingers, etc.;

(6) any communicable diseases, *e.g.*, tuberculosis, etc., of the milkman;

(7) the filth from the walls, ceiling and the dust and dirt laiden air of the cattle stables;

(8) the dirty milk vessels; and

(9) the *faulty water-supply.* The water-supply of the farm or cattle stable may become polluted by cases of cholera or typhoid on the premises. The writer isolated cholera vibrio from several wells in Bombay in June 1912, and again in August 1914. It

is quite common to have wells near cattle stables, the water being used for drinking and washing purposes.

During *Transit and Distribution*, the possible sources of bacteria are:

(1) The dust from the vitiated air of a crowded city street getting into the open or partially covered milk vessels.

(2) The peculiar concentric ring of hay, picked up from the filthy stables, or a piece of dirty rag which serves as a "*cover*" for the milk vessels in most cases.

(3) The filthy condition of third class cars on the suburban railways, and the manner of conveying milk in the same.

(4) The possibility of adulteration with filthy water during transit.

(5) The insanitary condition of the milkshops, where milk is exposed for sale in open vessels.

(6) The frequent handling of the milk while measuring it out to consumers.

(7) The filthy customs and habits of the retailer or hawker of milk in Indian cities; and

(8) *Flies.* The house flies are very common carriers of disease in India, and it is not at all uncommon to find them indulging in a bath in the open milk vessels. The contamination from each individual source may be small, but taken together from all the sources it would assume serious proportions.

It may be pointed out that a systematic and complete bacteriological examination of milk has never been attempted before by anyone in India, and consequently there are absolutely no data to start with. Considerable difficulty was experienced in the beginning to work out practical methods best suited for local conditions. The samples of milk were collected in special bottles provided for the purpose and were stoppered and sealed in the usual way. They were examined as soon as possible after collection. The following routine was followed in the examination of the samples:—

(1) *Preliminary dilution of the samples* with sterile water. These were made in a series of test-tubes

as follows :—1 : 10, 1 : 100, 1 : 1,000, 1 : 10,000, 1 : 100,000, and one in a million. These dilutions were used for (2) and (3).

(2) *Mircobe per cc.*—Agar plates were used for this purpose and a count was made after incubating for 48 hours at 37°C.

(3) *Lactose fermenters.*—MacConkey's Bile Salt Medium (with lactose) was used in Durham's fermentation tubes and the results noted with regard to acid and gas formation. The dilutions used were from 1 : 10 to 1 : 1,000,000.

(4) *B. enteritides sporogenes* (milk test only).—15 cc. of the sample were used. The milk was heated for 15 minutes at 80°C., rapidly cooled, incubated anærobically, and was examined for the characteristic changes from four to five days.

(5) *B. coli communis.*—This was isolated on Neutral Red Agar and examined for acid and gas formation (MacConkey's Bile Salt Media), and for Indol reaction, etc. By B. coli is understood the organism of Type A as mentioned by Houston on page 172 of his 'Studies in Water-Supply," 1913.

(6) *Cholera.*—Cultures were made on Peptone water and examined for cholera by cultural and biological tests in the usual way.

(7) *Typhoid.*—Drigalski Conradi's Medium and Neutral Red Agar were used.

(8) *Examination of the centrifugalised sediment.*—50 cc. of the milk was centrifugalised in the electric centrifuge for about ten minutes. Smears were made from the deposit, stained with Carbol-fuchsin (1 : 10) and examined microscopically for Leucocytes, Streptococci, Staphylococci, and other micro-organisms, etc., that may be present.

(9) *Tuberculosis.*—The results of examination for Tubercle bacilli are described separately on page 26.

The samples of milk examined bacteriologically may be divided into three classes : *Class I.* Those collected from healthy animals under the strictest precautions and examined *immediately* after collection. *Class II.* Those collected by the Chief Veterinary Inspector and his staff with ordinary precautions and sent to the

Laboratory, the time elapsing between the collection and examination varying from *three to four hours*. *Class III.* Those bought at random in the different wards of the city from dairies, milk-shops, cattle-stables, railway stations, gowlees, and other milk-vendors, by the staff of the Health Department. These samples fairly represent the quality of milk that is usually sold to the public in Bombay. As the "morning milk" is taken between 2 and 4 A.M., and sold a few hours later in the bazar, *six to nine hours* pass before it arrives for examination at the Municipal Laboratory. *Class IV.* Samples obtained from the Government Military Dairy in Bombay, the sources of the supply being Poona (Kirkee) and Ahmedabad. The milk is *pasteurised* and cooled and kept at a temperature between 40°F. and 50°F.

Class I. Samples collected from healthy animals under the strictest precautions.—Several cows and buffaloes belonging to a dairy were brought over to the Municipal Laboratory, after being examined by a veterinary surgeon and certified to be entirely free from disease. The animals were thoroughly scrubbed and washed. Just before milking, the udders and neighbouring parts were washed, first with an antiseptic solution, and finally with sterile water. The milking was done by the manager of the dairy himself, his hands being rendered surgically clean in the usual way. Most of the milk was drawn in sterile glass beakers, while a few drops were drawn directly into slant agar tubes. After making the necessary dilutions, the samples were immediately subjected to the routine examination for microbes per cc. lactose fermenters, etc., with the following results:—

1. *Microbes per cc.*—The average of several samples collected on two different occasions was found to be 292 *microbes per cc.* This was probably due to the too frequent manipulations involved in diluting the milk and preparing the plates, etc. The slant agar tubes in which milk was directly drawn were found to be *sterile*. This would indicate that milk drawn in small amounts, with strictest precautions from healthy and clean animals, is practically sterile.

2. *Lactose fermenters* were absent in 1 cc. and less of milk, in all the samples examined.

3. Examination for B. coli communis, B. enteritides sporogenes, Streptococci, Cholera vibrio, B. tuberculosis, and B. typhosus, was negative in every case.

These results compare favourably with those obtained by several observers in Europe and America.

Park* in 1901 found the average bacterial count per cubic centimeter in samples of milk from six separate cows examined five hours after collection to be 6,000, the lowest count being 400.

Von Freudenreich† (1902) obtained milk under the strictest aseptic precautions from 28 cows. The bacterial count of the mixed milk varied from 65 to 680 microbes per cc. Continuing his experiments, Freudenreich in 1903 ‡ examined the udders and the milk in the udders of 15 cows, in 13 cases immediately after slaughtering. The organisms found were mostly cocci. B. coli was never found.

Willem and Miele§ in 1905 examined a sample of milk containing 2·5 bacteria per cc. The milking was done in a special place. The udder and teats were washed with an antiseptic solution, and all possible precautions were taken during milking.

MacConkey in 1906|| found that with ordinary care and cleanliness it is possible to obtain milk which contains less than 1,500 microbes per cc. and in which gas-forming organisms are absent in less than 50 cc.

Class II. Samples collected by the Chief Veterinary Inspector and his staff with ordinary precautions. 68 samples were examined in all. The results are given in Table I (q.v.).

* Park. W. H. The great bacterial contamination of the milk of cities, &c. Journal Hyg., Vol. I, 1901, page 391.

† Von Freudenreich; Milchsäurefermente und Käsereifung. Cent. f. Bakt.; 2 Abt. Vol. 8, 1902, page 674.

‡ Von Freudenreich: Ueber das Vorkommen von Bakterien in Kuhenter. Cent. f. Bakt.; 2 Abt. Vol. 10, 1903, page 1901.

§ Willem & Miele: Procédé pour l'obtention dulait au aseptique Compte Rend. du 13 Cong. internat. d'Hyg. Brux. 1903, Vol. 3, page 67.

|| MacConkey: A Contribution to the Bacteriology of Milk. Journal of Hyg., Vol. 6, 1906, page 385.

It will be seen from this table that B. enteritides sporogenes, Cholera vibrio, and B. typhosus were not detected in any of the samples. B. coli was detected in 24 samples and Streptococci in two samples only. This leaves for consideration only microbes per cc. and lactose fermenting organisms. Taking first the *microbes per cc.*, it will be seen that the highest count was found to be 46,150,000 microbes per cc., while the lowest count was 450,000 microbes per cc. The average number expressed in millions was as follows :—

TABLE I.

Microbes per cc. in 68 samples (Class II).

MONTHS.	No. of samples.	Average No. of microbes per cc.	Average of 68 samples.
June 1913 ...	8	8,981,250	17,103,000
September „ ...	12	16,195,833	
December „	12	18,833,333	
January 1914 ..	6	10,416,000	
April „ ...	9	19,000,000	
May „ ...	21	19,767,000	

TABLE II. MILK SAMPLES.

Microbes per cc. in 68 samples expressed in millions (Class II).

Less than 1 million.	More than 1 but less than 3	Above 3 but less than 5.	Above 5 but less than 10.	More than 10 but less than 20.	Above 20 but under 50.
1	1	4	14	30	18

Most of the samples showed a count of more than five millions of microbes per cc.

The above figures are only approximate, for as Savage says: "There are no nutrient media and no

known conditions of growth which will allow all the bacteria in milk to develop."

Lactose fermenters.—Out of the 68 samples examined only four or 5·9 per cent. did not show any lactose fermenters in 1 cc. and less of milk. The following results were obtained :—

TABLE III.

Lactose fermenters in 68 samples of milk (Class II).

No. of samples.	1·0 cc.	0·1 cc.	0·01 cc.	0·001 cc.	0·0001 cc.	0·00001 cc.	0·000001 cc.	REMARKS.
4	–	–		–	–	–	–	About 6 % did not show lactose fermenters in 1 cc. and less of milk. The same percentage of samples showed lactose fermenters in a dilution of one in a million.
1	+	–	–	–		–		
5	+	+	+	–	–	–	–	
16	+	+	+	+	–		–	
21	+	+	+	+	+	–	–	
17	+	+	+	+	+	+	–	
4	+	+	+	+	+	+	+	
Total 68	samples.							

+ = Present. – = Absent.

B. coli communis was detected in 24 samples out of 68, or in about 35 per cent.

These results compare favourably with those obtained in the third series of samples. (*See* Table VI.)

Class III. Samples bought at random from a variety of sources, e.g., dairies, milk shops, cattle stables, railway stations, individual milk vendors or gowlees, &c. Two hundred and forty such samples were examined in the same manner as Series I and II. Only a brief summary of the results is given below :—

1. *Microbes per cc.*—The highest count was 118,400,000 microbes per cc. and the lowest was 250,000 microbes per c.c. during the period of about

12 months. The highest average figures were reached during May, as will be seen from Table IV.

TABLE IV.

Microbes per cc. average of 240 milk samples (Class III).

Months.	No. of samples.	Average of total count of microbes per cc. on agar at 37°C. for 48 hours.	Average mean temperature.	Average humidity.	REMARKS.
1913.			Fahr.°		
16th April ...	12	46,363,000	82·	·761	Average No. of microbes per cc. from April 1913 to July 1914, 36,385,000.
May ...	30	63,481,700	86·5	·723	
June ...	2	34,125,000	83·7	·822	
July ...	31	35,801,600	81·5	·864	
August ..	10	29,750,000	81·4	·815	
October ...	18	38,027,700	82·7	·785	
November ...	24	30,297,900	79·8	·697	
1914.					
January ..	18	30,905,000	79·8	·699	
February ..	24	26,366,000	76·	·684	
March .	21	26,131,000	78·	·784	
April ...	18	22,105,000	82·	·747	
June ...	16	35,462,000	...	...	
July ..	16	39,025,000	...	...	
Total ...	240				

TABLE V.

Microbes per cc. in 240 samples of milk expressed in million (Class III).

More than 1 but less than 5 millions.	More than 5 but less than 10.	More than 10 but less than 20.	More than 20 but less than 30.	More than 30 but less than 50.	More than 50 millions.
3	9	32	82	68	46

The majority of samples (nearly 82%) showed a count of more than 20 millions; while about 19% showed more than 50 millions of microbes per cc.

2. *Lactose fermenters.*—The results are tabulated below :—

TABLE VI.

Lactose fermenters in 240 samples of milk (Class III).

No. of samples.	1 cc.	0·1 cc.	0·01 cc.	0·001 cc.	0·0001 cc.	0·00001 cc.	0·000001 cc.	
2	+	+	+	+	-	--		+ = Present.
17	+	+	+	+	+		-	- = Absent
40	+	+	+	+	+	+		
181	+	+	+	+	+	+	+	
Total 240								

All the samples showed the presence of lactose fermenting organisms in 1 cc. and less of milk. Out of the 240 samples, 182 or 75·8% showed lactose fermenters in the weakest dilution used, *viz.*, in 0·000001 cc. of milk. Lactose fermenters were found to be absent in 0·0001 cc. and *less* of milk in two samples only. These results are extremely bad compared to those in Table III. (q.v.)

TABLE VII.

Microbes per cc. in Bombay milk (Class III)—240 samples.

(Distributed according to Wards.)

Ward.	No. of samples.	Average No. of microbes per cc. from April to July 1914.	REMARKS.
A	37	34 331,000	
B	38	40,081,000	
C	35	37,744,000	
D	33	39,963,000	Average 38,162,000
E	39	37,786,000	
F	28	49,218,000	
G	30	28,013,000	
TOTAL ...	240	....	

Table VIII.

Lactose fermenters in Bombay milk (Class III).
(Distributed according to Wards.)

Ward.	No. of samples.	1 cc.	·1 cc.	·01 cc.	·001 cc.	·0001 cc.	00001 cc.	·000001 cc.
A	3	+	+	+	+	+	−	−
	8	+	+	+	+	+	+	−
	26	+	+	+	+	+	+	+
Total ...	37							
B	1	+	+	+	+	+	−	−
	2	+	+	+	+	+	+	−
	35	+	+	+	+	+	+	+
Total ...	38							
C	2	+	+	+	+	+	+	−
	33	+	+	+	+	+	+	+
Total ..	35							
D	1	+	+	+	+	−	−	−
	3	+	+	+	+	+	+	−
	29	+	+	+	+	+	+	+
Total ..	33							
E	2	+	+	+	+	+	−	−
	12	+	+	+	+	+	+	−
	25	+	+	+	+	+	+	+
Total ...	39							
F	3	+	+	+	+	+		
	7	+	+	+	+	+	+	−
	18	+	+	+	+	+	+	+
Total ...	28							
G	1	+	+	+	+	−		−
	8	+	+	+	+	+		−
	5	+	+	+	+	+	+	
	16	+	+	+	+	+	+	+
Total .	30							
Grand Total	240							

+ = Present. − = Absent.

3. *B. enteritides sporogenes* (milk test only). 29 samples out of 240 or 12% gave positive tests with the production of the characteristic changes in the milk.

Animal experiments were tried in a few cases but with negative results.

4. *B. coli* was detected in 225 samples out of 240, giving 93·7 per cent, as compared with 35·3% in Series II.

5. *Streptococci.*—The centrifugalised stained deposit examined microscopically showed the presence of streptococci in 28 samples out of 240 or in 11·7% as against 2·9% in Series II.

6. *Examination for B. typhosus, B. tuberculosis and Cholera vibrio was negative in all cases.*

Class IV. 118 special samples collected from the Government Military Dairy, Bombay.—The milk is supplied daily from Poona (Kirkee) and Ahmedabad. It is first pasteurised at 170°F. for two minutes, rapidly cooled down to nearly freezing point, and then brought to Bombay in special cans with cold packing outside. After arrival in Bombay, the milk is again pasteurised, cooled and held at a temperature of between 40° and 50°F. The samples were collected in special bottles packed in a case containing ice and were examined immediately after arrival at the Municipal Laboratory. The results are tabulated below :—

TABLE IX.

Microbes per cc. in 118 samples of milk (Class IV).

Source of supply.	Months.	No. of samples examined.	Average number of microbes per cc.
	1914.		
Poona	August ...	11	9,407,000
"	September ...	20	12,845,000
"	October ...	19	16,650,000
"	November ...	21	14,390,000
"	December ...	5	11,618,000
Poona	Total	76	13,644,000
Ahmedabad ..	August ...	12	9,462,000
" ...	September ...	20	12,528,000
" ...	October ..	10	18,107,000
Ahmeda	bad Total ..	42	12,980,000
GRAND	TOTAL AVERAGE ...	118	13,408,000

The average number of microbes per cc. in 188 samples examined was about 13 millions; these figures compare favourably with those found in Bombay Milk (*Class III*, see Table IV.).

All the above samples showed lactose fermenters in 1 cc., ·1 cc., and ·01cc.; only two from Ahmedabad and three from Poona showed their presence in a dilution of one in a million, as detailed in the following statement :—

TABLE X.

Lactose fermenters in 118 samples of milk (Class IV).

Source of supply.	No. of samples.	DILUTION OF MILK USED.						
		1 cc.	·1 cc.	·01 cc.	·001 cc.	·0001 cc.	·00001 cc.	·000001 cc.
Ahmedabad ...	2	+	+	+	+	–	–	–
" ..	8	+	+	+	+	+		–
"	30	+	+	+	+	+	+	–
" ..	2	+	+	+	+	+	+	+
Poona .	2	+	+	+	+	–	–	–
" ..	31	+	+	+	+	+	–	–
"	40	+	+	+	+	+	+	–
"	3	+	+	+	+	+	+	+

+ = Present — = Absent.

It has been shown that in the case of Bombay milk the majority of samples showed lactose fermenters in one in a million, while in the above samples lactose fermenters were present in a dilution of one in a 100,000.

Neither *B. coli* nor *B. E. sporogenes* were detected in any of the above samples. The centrifugalised stained deposit, examined microscopically, did not show any streptococci. These favourable results are to be ascribed to the fact that all the above samples were pasteurised before collection.

Some remarks may be now made regarding the significance of some of the foregoing results (*microbes per cc.*) As has been already said, all the colonies counted at any one time do not by any means give a *true* count of all the bacteria present in milk, for there are many varieties of microbes found in milk that it is

impossible for them *all* to grow on the same medium. It can not be denied, however, that the count has a *relative* value when made under precisely identical conditions. It may be argued that all the bacteria found in milk are not harmful. It must be remembered, however, that milk containing an excessive number of microbes can not be said to be suitable food, particularly for infants. Besides 93·7% of the samples examined showed the presence of *B. coli communis*. Unfortunately, milk is not a transparent liquid, or else the enormous growth of microbes would have been quite visible to the naked eye. To get some idea of the bacterial counts found in Bombay, the figures may be compared to those of sewage in London and Boston, and milk in London, New York, Boston, and Bombay.

		Average for	Microbes per cc.	Name of the investigator or authority.
Sewage.	1. London	1894 to 1901	2,000,000 to 11,000,000	Rosenau
	2. Boston.	1894 to 1901	2,800,000	Rosenau.
Milk.	1. London	Dec to Feb.	3,000,000 to 5,000,000	Eyre.
	"	June to Sept.	20,000,000 to 30,000,000	Eyre.
	2. New York...	In Winter	1,000,000	Park
	"	In Summer	5,000,000	Park.
	3. Boston	1904	2,300,000	Bergey.
	4. Bombay	April 1913, to July 1914 (240 samples) ...	36,385,000	Joshi.

It must be borne in mind that too much stress should not be laid on these statistics, as different investigators may have employed different methods, and the results may not be strictly comparable. At any rate, it is quite evident that Bombay enjoys the dubious honour of standing *first* in the above list.

There are at least *three main factors which influence the multiplication of bacteria in milk:* (1) *Time*, (2) *Temperature*, and (3) *Conditions of collection, storage and distribution of milk.*

1. Time.—By "Time" is meant the interval between the withdrawal of milk from the cow or buffalo

and its examination at the Laboratory. A glance at the figures given below and on page 20 will show the following :—

Number of samples.	Class.	"Average time."	Average number of microbes per cc.
....	I	Immediate examination	292
68	II	3 to 4 hours.	17,103,000
240	III	6 to 9 hours	36,385,000

In these experiments, the temperature was practically constant, but the conditions of collection, etc., were different and this must be borne in mind when comparing the results. The influence of *time* on the growth of bacteria in milk obtained under aseptic conditions has been observed in several samples examined in Bombay by the writer. The following figures are typical of many others. The sample was collected with strict precautions. Just before milking, the udders and neighbouring parts were washed, first with an antiseptic solution and finally with sterile water. The hands of the milker were rendered surgically clean in the usual way and the milk was drawn in sterile glass flasks.

	Microbes per cc.	Lactose fermenters.
Shortly after milking the sample contained ...	198	in 1 cc. & less.
One hour after milking the sample contained...	304	– in 1 cc
Two " " " " ...	624	in 1 cc.
Three " " " " ...	1,035	- in 1 cc.
Four " " " " ...	7,200	+ in ·1 cc. & more.
Five " " " " ...	19,400	+ in ·1 cc & more.

+ = Present. – = Absent.

The following figures from Freudenreich are also very instructive :—

Shortly after milking the sample contained ...	9,000 Mic. per cc.
1 hour " " " ...	31,750 " "
2 " " " " ..	36,250 " "
4 " " " " ...	40,000 " "
7 " " " " ...	60,000 " "
9 " " " " ...	120,000 " "
25 " " " " ...	5,000,000 " "

It may be concluded that under identical conditions of collection, transportation, etc., and with a constant optimum-temperature, the longer a milk sample is kept, the greater the number of bacteria in it.

2. Temperature.—This is a very important factor here in India. It has been found that the majority of bacteria met with in milk grow best at about 25°C. to 35°C. or (77°F. to 95°F.). At lower temperature (15°C. and below) they multiply very little. At higher temperature, the different bacteria have their different *thermal death points.* In other words, a certain amount of heat is essential and a certain amount is fatal to the growth of bacteria. Each particular variety of bacteria grows best at a certain temperature called the *optimum ;* each also has an upper and a lower temperature limit beyond which its growth is arrested. The accompanying diagram illustrates these points*.

The atmospheric temperature in Bombay corresponds very closely to the most favourable temperature for bacterial growth in milk, namely, 25°C. to 35°C. or 77°F. to 95°F., and accounts partially for the high counts obtained. It will be seen from table 'V' that the highest number of microbes per cc. (63 millions) was found during May which is the hottest month in Bombay and Western India, the average mean temperature during May 1913 being 86·5. In July and August, on account of the monsoon, it is comparatively cooler in Bombay and correspondingly the figures show a lower count (29 to 35 millions) than in May. In October the temperature again rises (82·7) and with it the number of microbes. From November to February there is a gradual decline both in temperature and in the number of bacteria.

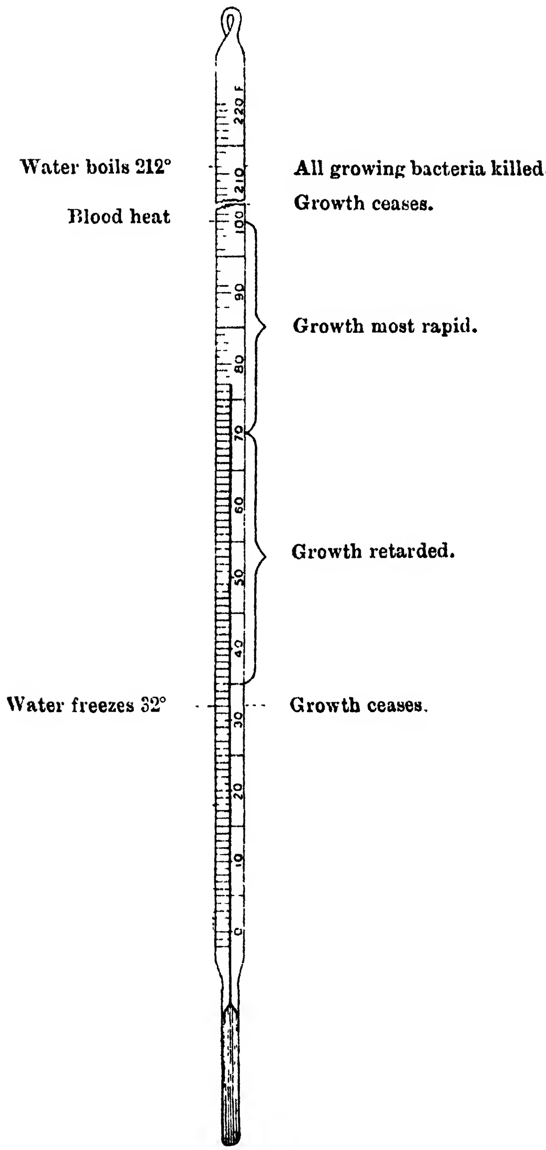
The relative increase of bacteria in milk held at different temperatures are given as follows :—

Milk held at	Relative number of bacteria at the end of—				
	0 hour.	6 hours.	12 hours.	24 hours.	48 hours.
68°Fahr. ...	1	1 7	24·2	6,128·0	357,499·0
50°Fahr. ...	1	1·2	1·5	4·1	6·2

"In the foregoing table, 1 is assumed to represent the numbers of bacteria in the fresh milk, and the relative numbers which will be found at the end of six, twelve, twenty-four and forty-eight hours, at the two temperatures, are shown in the succeeding columns.

* U. S. Department of Agriculture, Bulletin 348, pp. 10 and 11.

INFLUENCE OF TEMPERATURE ON THE GROWTH OF BACTERIA ORDINARILY FOUND IN MILK.



These figures are based on a number of actual counts and illustrate the effect of a difference of 18° on the multiplication of bacteria. If the milk had contained at the beginning 1,000 bacteria, the part held at the lower temperature would have contained at the end of twenty-four hours 4,100 bacteria, while the other would have contained at the same stage, 6,128,000."

3. Conditions of collection, distribution, etc.—The cleanliness of the methods employed in milking, etc., has a direct bearing on the bacterial content of milk. It affects not only the total *number* of bacteria but also the *kind* of bacteria in milk. The dirtier the milk the greater is the number of microbes in it. This has been clearly proven by the results already tabulated in the case of all the *four different classes of samples collected* under widely different conditions.

To sum up; the enumeration of microbes per cc. in milk serves as an index to its (1) age, (2) temperature at which it was held, and (3) the cleanliness of the methods employed in its collection, etc. A favourable combination of all these three factors will result in an excessive multiplication of the bacteria present.

As regards the presence of *Lactose Fermenting Organisms and B. coli* in Bombay milk, a comparison may be made between the figures in table III and those in table VI. In the former case only 5·9% of samples showed lactose fermenters in 0·000001 cc. and more of milk, while in the latter case the percentage of samples showing lactose fermenters in the same dilution was 75·8 or nearly twelve and a half times as much. In the former *B. coli* was found in 35·3% of the samples, while in the latter in 93·7%. The presence of organisms of the *B. coli* group in such large numbers indicates pollution with cow-dung, etc. This is not at all astonishing when one remembers the filthy condition of the stables, etc., where milking is usually carried on. Out of the samples of milk collected with the strictest sanitary precautions not one showed any "fæcal bacilli." This taken together with the results tabulated in tables III and VI would indicate that *the presence and the number of lactose fermenting organisms of the* B. coli *type in milk depend mostly on the amount of cleanliness observed in the*

collection, storage, and distribution of milk. The figures for milk of *Class III* (Table VI) show an appalling amount of manurial and other undesirable pollution of Bombay milk as is ordinarily found in the local market dairies, milk-shops, etc. The figures obtained in samples of *Class II* and *Class IV* demonstrate the advantages of cleanly methods in handling milk.

The *kind* of bacteria found in milk are more important, than the mere enumeration of the total *number* of all bacteria. The presence of *B. coli* in about 94 per cent. of Bombay milk and the detection of lactose fermenters in a dilution of one in a million of milk clearly show that the Bombay milk supply is grossly contaminated with manure and other dirt. The conditions of a perfect bacterial indicator are defined as follows by William G. Savage:—1. It should be abundant in the substances for which its presence serves as an indicator. 2. It should be absent, or at least relatively absent, from all other sources. 3. It should be easily isolated and numerically estimated. 4. Its characteristics should be definite and not liable to variation, whereby its distinctive character might be impaired.

B. coli, as an indicator of the manurial contamination of milk, fulfils all these conditions very adequately. The same may be said regarding the organisms which are closely allied to *B. coli*. The enumeration of *B. coli* and allied organisms in a sample of milk may be taken generally as a fairly reliable measure of the degree of pollution of that sample. It is however by no means quite so simple to interpret correctly the significance of the presence and number of *B. coli* and allied organisms in milk. A great deal would depend upon *time* and *temperature* as discussed already. If it were a universal custom to thoroughly cool milk and maintain it at a temperature so low that *B. coli* could not multiply in it, then one could lay down definite standards for *B. coli* by which the amount of pollution could be measured. Bearing in mind the various insanitary conditions under which milk is collected and distributed in India, and the various local factors, *e.g.*, favourable temperature for bacterial growth, etc , it may be assumed that *the presence of* B. coli *and allied organ-*

isms in large numbers indicates manurial and other undesirable pollution of milk.

B. enteritides sporogenes in milk.—It has been shown that the *spores* of this organism are present in considerable numbers in cow-dung. According to Savage, the estimation of the number of spores in milk is valuable, as *B. enteritides sporogenes* is an organism which does not multiply in milk. The ordinary test for the detection of this bacillus cannot be considered as conclusive. In 29 out of 240 samples (12 %) *B. enteritides sporogenes* was found in Bombay. Whatever may be the significance of its presence it does not seem to be very common in Bombay milk.

Microscopic examination of the centrifugalised and stained sediment.—A microscopic study of the milk sediment gives one a general idea of the number and kind of bacteria and of the cellular elements present. The presence of streptococci, pus cells, leucocytes, etc., can be detected by microscopic examination. Besides, one can obtain general information concerning the nature of the dirt in the milk sample. The centrifugalised sediment is composed partly of cellular elements, *e.g.*, leucocytes, etc., and partly of bacteria, sand and dust particles, cotton fibres, hairs, manurial matters, and particles of straw 'kadbi,' and other feed. After a little practice one can fairly distinguish certain types of bacteria which are characteristic of stable-refuse, cow-dung, etc. A high leucocyte count accompanied by streptococci usually indicates diseased udders. The presence of pus cells may indicate purulent inflammation of the udders. Microscopic examination would be of great value when the source of the sample is known, for then the diseased animal could be traced.

The significance of streptococci in milk.—The streptococcus which is usually associated with mastitis is called *streptococcus mastitides* by Savage. Out of 36 cases of mastitis in cows investigated by Savage, nearly 75 per cent. were due to streptococci. Further investigations were made by Savage to determine whether these streptococci are pathogenic to man. He made a comparative study of the human and bovine groups of streptococci with regard to their virulence, etc. He found that although the two groups were

morphologically and culturally indistinguishable, "they showed a wide divergence when their action towards animals was considered." Savage concludes from his researches that "under ordinary conditions the *streptococcus mastitides* is not a cause of human disease."

Moore found streptococci associated with many diseases of cattle, sheep and horses. Streptococcus* has been also found in milk derived from healthy udders. Reed and Ward observed this in the case of a cow from 1897 to 1900.† A *post-mortem* examination of the glandular tissue of the udder was made and streptococci were isolated.

Pus cells in milk.—It is not easy to accurately distinguish between pus cells and leucocytes in milk. A leucocyte in fluids other than blood-milk for example, soon undergoes changes which render it almost indistinguishable from a pus cell. Some observers regard all noticeably clumped cells as pus cells. Others regard all poly-nuclear neutrophilic cells as pus cells. The writer distinguishes a normal healthy leucocyte from a pus cell in that the latter is regarded by him as a leucocyte in a state of degeneration, showing a swelling of the cell, which contains granular detritus.

Stokes and Wegefarth carried out a systematic examination of milk for pus cells. The samples were obtained from *three grades* of cows kept under different sanitary conditions.

(1) *First grade.* 100 cows kept in the country in a modern, sanitary stable and milked in a cleanly manner. The average of ten microscopic fields showed *1·1 pus cell* to a single microscopic field. (2) The second grade consisted of 50 cows kept in the country, but in a badly ventilated and dirty stable. No precautions were taken in collecting the milk. The samples were examined in the same way as (1) and gave an average of *11·3 pus cells* to a single field. (3) The third grade consisted of 100 cows kept in the city, always confined in a filthy stable. The milk was collected under veterinary supervision and on being examined in the same manner

* Moore's "Observations concerning the significance of Streptococci in comparative Pathology."—*American Vet. Review*, 1900, Vol. XXIII.

† H. C. Reed and A. R. Ward, "Streptococci in Market Milk."—*American Medicine*, February 14th, 1903, page 257.

gave an average of *19·2 pus cells* to a single microscopic field.

From these results the obvious conclusion is drawn that cows kept in the country under sanitary and hygienic conditions are less capable of causing disease through their milk than those kept in the city under the conditions of grade 3. In Bombay and other large Indian cities, most of the milk is obtained from cattle kept under conditions of grade 3. 308 samples of mixed market milk were examined microscopically by the writer. All contained leucocytes in varying numbers, the polymorphonuclear variety being predominant. True pus cells were very rarely found. *Streptococci* were found only in *2·9 per cent.* of samples of *Class II*, but in *11·7 per cent.* of samples of *Class III*.

Miller* draws the following conclusions with regard to leucocytes and streptococci in milk :—

1. Many leucocytes and streptococci are present in the normal milk of a healthy cow.

2. Leucocytes and streptococci are as a rule more numerous in the milk of diseased than in that of healthy cows.

3. No satisfactory method has been devised for distinguishing the pathogenic from the non-pathogenic streptococci in milk. Their significance is therefore a matter of further study.

Tubercle bacilli in milk.—The following figures will show the frequency with which tubercle bacilli have been found in milk in English and American cities : —

CITIES.	No. of samples examined.	Percentage containing tubercle bacilli.	Investigator or Authority.
London (1908) ...	..	11 6	William G. Savage.
Manchester (1908)...	...	8 28	William G. Savage.
New York (1910) ...	107	16 0	Hess.
Chicago (1910) .	144	10·5	Tonney.
Washington (1906)	233	6 7	Anderson.

Are tubercle bacilli conveyed by milk in India?— A systematic examination of Bombay milk for *B.*

* Miller, Wm. W.—"The significance of leucocytes and streptococci in milk." *Hyg. Lab., Bull.* No 56, March, 1909.—*Washington, U. S. A*

tuberculosis was made by me during four years (1910—1913 inclusive). The total number of the samples examined was 741. 48 samples, or 6·47 per cent. showed the presence of *Acidfast bacilli*, but *in not a single sample tubercle bacilli could be demonstrated by animal experiments.* These results have been confirmed independently by those at the Bombay Bacteriological Laboratory, Parel, where 100 samples of cows' milk were recently examined for tubercle bacilli, but *in no instance did the guinea pigs develop tuberculosis.* Further investigation in other cities of India is necessary before drawing final conclusions, but so far as our present knowledge goes, it may be concluded that *in India tubercle bacilli are rarely, if at all, conveyed by milk.*

The value of bacteriological examination of milk in India cannot be denied in the light of the foregoing results. Chemical examination is no doubt important, as it gives us information as to whether a sample of milk is genuine or not, that is, whether it is "watered" or deficient in fat, etc. If clean and pure water be added, it would not be directly injurious to health. If, however, a sample of milk shows a very high count of bacteria, most of which are of fæcal origin, or the presence of a pathogenic microbe like cholera or typhoid, then its bearing on public health is quite obvious. Again, a sample of milk may be quite genuine from a chemical point of view but very objectionable from a bacteriological standpoint. The following two samples (A and B) may be cited to illustrate this point :—

Date.	Samples.	CHEMICAL EXAMINATION.				BACTERIOLOGICAL EXAMINATION.	
		Spec. grty. at 60°F.	Total solids. %	Fat. %	Non fatty solids. %	Microbes per cc.	Lactose fermenters present in—
23-7-13	'A'	1030	17·14	6·5	11·14	47,100 000	·000001 cc. & more.
6-8-13	'B'	1026	15·44	6·4	9 04	52,850,000	·000001 ,, ,, *B. coli* present in both.

Both the samples are *genuine* from a chemical point of view. Bacteriological examination shows,

however, a very high count presence of lactose fermenters in 0·000001 cc. and more, and the presence of *B. coli communis.* Surely, such samples cannot be considered harmless specially for the tender gastro-intestinal mucous membrane of an infant.

In a routine bacteriological examination of milk in India, it would be necessary to adopt only the following procedure :—

1. Microscopic examination of centrifugalised sediment especially for leucocytes, pus cells, and streptococci ;
2. No. of microbes per cc. (count on agar plates) ;
3. Lactose fermenters in different dilutions ; and
4. Examination for *B. coli communis*, and *B. enteritides sporogenes.*

Dr. Eastwood in his report to the Local Government Board (1909) on American Methods* emphasises the great importance of bacteriological examination of milk in the interests of public health. A knowledge of the bacterial content of milk is very useful in the control of the milk-supply of a city. Dr. Eastwood says that "the results already obtained in America by the use of bacteriological methods are worthy of admiration." The following example from a Philadelphia report is quoted by him to illustrate the prompt efficacy of the microscopic examination of milk. "Recently a child was made sick by the use of milk ; the sample, which was sent to the laboratory, was found to contain pus and streptococci in large numbers. The dairyman was notified, his herd inspected, and the infected cows excluded within six hours" The results achieved by Dr. Goler, Health Officer of Rochester, N. Y., in the improvement of the milk-supply of that city are also worth mentioning. The City of Rochester, N. Y., has a population of 200,000 who use 70,000 quarts of milk daily. "Every year, bacterial counts of 1,000 samples are made ; fifty per cent. of these now yield less than 100,000 bacteria per cc. Dr. Goler is a

* (New Series No. 1) Dr. Eastwood's report to the Local Govt. Board on American Methods for the control and improvement of the milk-supply, 1909, page 60.

strong believer in the value of the bacterial count, and considers that the reduction which he has effected in the bacterial content of Rochester milk is one of the causes which have brought about a diminution of infantile mortality." Dr. Eastwood concludes:

"Routine:—Bacteriological examinations of samples for the guidance of the milk inspection service, are valuable, and should be adopted. They afford the most reliable, the cheapest, and often the quickest means of discovering when milk has been improperly handled."

"The practical importance of the work is well put by Rosenau, 'The activities of our health officer were at first directed almost exclusively to the prevention of sophistication of milk, detected by chemical methods, to the neglect of the valuable information obtained from bacterial examinations. The addition of water to milk and the extraction of cream are fraudulent practices, but, as a rule, have only a secondary bearing upon the public health. The bacteriological examination of milk gives us a clue to the cleanliness of the methods employed, the temperature, and the age of the milk. The health officer who has the advantage of bacteriological assistance knows that the milk of dairies containing excessive numbers of bacteria is dirty, old, or warm. With a bacteriological count as a guide it is comparatively easy to determine the cause of the trouble and to institute proper means to correct it. The enumeration of bacteria in milk is, therefore, one of the readiest and cheapest methods at the disposal of health officers to determine the general sanitary quality of the market milk-supply. The laboratory results serve not only as a guide to direct the efforts of the health officer, but confirm the conclusions arrived at from an inspection of the dairies and dairy farms.' I consider that Rosenau's statements are fully justified by what has already been accomplished in America."

Bacterial Standards.

The first attempt to adopt a bacterial standard was made by the New York Board of Health in 1900. According to this, no milk was allowed to be sold in New York which contained over 1,000,000 bacteria per

cc. This standard was considerably modified later on. Boston has a *legal standard* of 500,000 microbes per cc. According to Rosenau the number of bacteria per cc. in clean milk should never exceed 100,000. It must be remembered that conditions in America are quite different from those obtained in India and if a standard is to be adopted in India, it should be done with due regard to the various factors which affect the bacterial contents of milk in India, the most important of these being (1) the local conditions of collection and distribution of milk; (2) temperature at which the milk is held; and (3) time elapsing between the collection of the milk and its consumption.

A bacterial standard should not consist merely of the minimum number of microbes per cc. The *kind* of bacteria in milk are even more important than the *number*, and this must be taken into consideration in fixing the standards. There are many difficulties in the way of adopting *numerical* bacterial standards and at the present stage of our knowledge, it is questionable whether such a standard should be fixed for *legal* purposes. Bacterial standards for milk in India would be, however, very useful as guides for *administrative* purposes. Further research is necessary before fixing any permanent bacterial standards for India. In the meantime, in the light of the results obtained in Bombay, the following standard for *pure milk* is suggested as a provisional measure for Bombay.

1. *Microbes per cc.* The total number of microbes per cc. should not exceed two millions during the cold weather (November to March) and five millions during the hot and rainy seasons (April to October).

2. *Lactose fermenters.* These should be absent in 1 cc. of the sample, if it is taken with strict sanitary precautions.

(a) *During the cold season (November to March)* the same is of—

Pure milk,	if lactose	fermenters	are	absent	in	1 cc. and less.
Good	„	„	„	„	„	0·1 cc. and less
Fair	„	„	„	„	„	0·01 cc. and less.
Bad	„	„	„	present	„	0·01 cc.
Very bad	„	„	„	„	„	0·001 cc.
Contaminated	„	„	„	„	„	0·0001 cc.
Highly contaminated		„	„	„	„	0·00001 cc.

(b) *During the hot weather and monsoon (April to October).*

Pure milk,	if	lactose	fermenters	are	absent	in	0·1 cc. and less
Good	,,	,,	,,	,,	,,	,,	0·01 cc. and less.
Fair	,,	,,	,,	,,	,,	,,	0·001 cc. and less
Bad	,,	,,	,,	,,	present	,,	0·001 cc.
Very bad		,,	,,	,,	,,	,,	0·0001 cc.
Contaminated		,,	,,	,,	,,	,,	0·00001 cc.
Highly contaminated			,,	,,	,,	,,	0·000001 cc.

3. *Microscopic examination of the centrifugalised sediment* should show only a few leucocytes and perhaps a few cocci and bacilli but pus cells and (pathogenic) streptococci should be always absent. There should be no leucocytosis, especially of the polymorphonuclear variety.

4. *Pathogenic microbes, e.g.,* tubercle bacilli, cholera vibrio, B. typhosus, etc., must be *absent.*

Legal provision to prevent the contamination of milk with pathogenic microbes, and with bacteria indicating cow-dung and other dirt.

No such provision exists at present. The practical importance of the bacteriological examination of milk has been already pointed out. The dirt content of milk is sometimes determined by filtration (*e.g.*, with "Gerber's dirt tester") or by sedimentation by the centrifuge. The latter method was used by Delèpine* for estimating the amount of dirt in Manchester milk. Such methods may be used for getting a rough idea for gross dirt usually present in milk, *e.g.*, remnants of feed, cow hairs, etc. A great deal of the dirt, however, is dissolved in the milk,† which cannot be determined by these methods. Even if the amount of sediment be accepted as a reliable measure of the dirt in milk, it cannot give any information regarding its *character.* This can be ascertained only by microscopic and bacteriological examinations. A knowledge of the bacterial content of milk is essential in order to determine the age of the milk, the quality and character of

* Delèpine, "Report to the Manchester Sanitary Committee." 1908.
† William Ernst, "Text-Book of Milk Hygiene," 1914, page 215.

the dirt present and the presence or absence of objectionable bacteria. It would also serve as an index of the cleanliness of the methods employed in the handling of milk. *Pure milk* implies four separate requirements :—

1. *Genuine milk*—that is the whole milk without addition or abstractions.

2. *Milk*—derived from *healthy animals.*

3. *Clean milk*—that is milk so collected, transmitted and vended that it is free, or reasonably free, from manurial or other objectionable pollution.

4. *Milk uninfected*—with the organisms or specific diseases, *e.g.*, cholera, typhoid fever, tuberculosis, etc.

The first requirement is determined by chemical analysis and the second by veterinary inspection. The third and fourth requirements can be determined only by a *bacteriological examination of milk.* Savage* is of opinion that to ensure a reasonably clean milk supply, bacteriological examinations are essential and nothing can take their place. Detection of dirty procedures is only possible by bacteriological examination.

The question of fixing *legal bacterial standards* for milk in India will have to be faced sooner or later. Unfortunately very little work has been done in this country regarding the bacteriology of milk. So far as the writer is aware, the work described above is the *first* systematic attempt ever made in India for finding out the bacterial content of milk, and for proposing certain bacterial standards. There is now a large number of well-equipped bacteriological laboratories in India and it is suggested that a systematic bacteriological examiation of milk may be carried out there, with a view of determining the local bacterial standards. In the meantime, so far as Bombay is concerned, it may be worth while to try the tentative bacterial standards proposed above. If they are found to be useful and practical from the administrative point of view, they may then be legalised at least for the city of Bombay.

* William G. Savage, "Milk and the Public Health," 1912.

Summary and Conclusions.

1. *The principal factors affecting the bacterial content of milk are:—*

(*a*) *Climatic influences*—temperature, humidity, etc.

(*b*) *Conditions relating to the milch cattle, e.g.*, the various diseases of animals, their housing and care, etc.

(*c*) *Conditions to be ascribed to the producers, dealers and vendors of milk, e.g.*, insanitary habits of life, objectionable methods of milking, and of storing and transporting milk, communicable diseases of milkmen, *e.g.*, tuberculosis, typhoid, cholera, etc.

2. Four classes of milk samples were examined bacteriologically in Bombay:—

Class I.—Samples taken from healthy cows and buffaloes which were specially brought to the municipal laboratory. These were collected under the strictest personal supervision and examined immediately after collection.

Class II.—Samples collected in sterile bottles by the veterinary inspectors with ordinary precautions, and examined three or four hours after collection.

Class III.—Samples bought at random from various sources in the city from cattle-stables, dairies, railway stations, milk-shops, individual vendors and hawkers. This represents the ordinary market milk of Bombay.

Class IV.—Samples of pasteurised milk obtained from the Government Military dairy, Bombay.

3. The milk samples were examined as follows:—

Enumeration of microbes per cc.

Lactose fermenters in dilutions of 1 : 10 to 1 : 1,000,000.

Microscopic examination of the centrifugalised sediment including search for leucocytes, pus cells, *streptococci* and *staphylococci*. Examination for tubercle bacilli including animal experiments. Cultural and other tests for *B. typhosus, cholera vibrio, B. colicommunis* and *B. enteritides sporogenes.*

4. In samples of *Class I*, the results obtained were almost ideal. The average number of microbes was 396 per cc.; Lactose fermenters were absent in 1 cc.

and less of milk and the examination for pathogenic microbes was negative in all cases.

5. 68 samples of *Class II* were examined with the following results :—

(*a*) *Microbes per cc.* (average of 68 samples) were 17 millions.

(*b*) *Lactose Fermenters*, only four samples or 5·9 per cent., showed their presence in a dilution of one in a million.

(*c*) *Streptococci* were detected only in two samples ; while

(*d*) *B. Coli* in 24 samples or in about 35 per cent. samples.

(*e*) Examination for *other microbes* was *negative.*

These results compare favourably with those obtained in *Class III.*

6. 240 samples of *Class III* were examined with the following results :—

(*a*) *Microbes per cc.* The average was about 36 millions.

(*b*) *Lactose Fermenters* In 75·8 per cent. samples they were present in a dilution of one in a million.

(*c*) *Streptococci* were detected in 11·7 per cent.

(*d*) *B. Coli* was present 93·7 per cent. ; other microbes were absent.

These results are extremely bad when compared with those of *Class II.*

7. 118 samples of *Class IV* were examined with the following results :—

(*a*) *Microbes per cc.* The average was about 13 millions.

(*b*) *Lactose Fermenters.* In 63·5 per cent. of the samples examined, they were present in a dilution of 1 : 100,000, and in 96·6 per cent. in a dilution of 1 : 10,000.

(*c*) *B. Coli, B. enteritides sporogenes, and streptococci were absent.*

8. These widely different results of the bacteriological examination are mainly dependent on (*a*) the different *conditions of collection and distribution* of the milk samples; (*b*) the *time* elapsing between milking and examination of the samples at the laboratory; and (*c*) the *temperature* at which the milk samples were held.

9. The favourable results obtained in samples of *Class I*, from a bacterial standpoint, show that it is *quite possible to get the purest milk in Bombay*, provided that proper precautions are taken regarding milking, etc.

10. The results of bacteriological examination of samples of *Class II* indicate that even with ordinary precautions, a great deal of the objectionable contamination of milk can be avoided.

11. As regards the results obtained in samples of *Class III*, it is quite evident that this means a very *high degree of manurial and other undesirable pollution of the Bombay milk-supply.* The series included several samples of milk which were quite *genuine* as regards their chemical composition, being free from adulteration with water; but a bacteriological examination revealed much *contamination* with cow-dung and other filth!

12. The comparatively favourable bacterial results obtained in samples of milk which were pasteurised and then kept constantly at a temperature under 50°F., demonstrate the advantages of pasteurised milk over raw milk.

13. As regards *tuberculosis*, out of 741 samples of milk examined during four years not a single sample showed the presence of tubercle bacilli. These results have been since confirmed, independently, at the Bombay bacteriological laboratory, Parel, where similar results were obtained It may be concluded that so far as our present knowledge goes, *tuberculosis is rarely, if at all, conveyed by milk in India.*

14. The ordinary physical tests used for the determination of dirt in milk (*e.g.*, filtration, sedimentation) are not reliable. The *amount* and *quality* of the dirt present can be ascertained only by *microscopic* and *bacteriological examination.* The bacterial content of the milk is an index of the cleanliness of the methods employed in the handling of milk.

15. The above investigation has demonstrated the practical importance of the bacteriological examination of milk in India. It cannot be denied that much valuable information can be obtained from a bacteriological examination of milk.

16. As regards *bacterial standards for milk*, it may not be considered desirable at present to adopt them for *legal* purposes; but undoubtedly they would be very useful as guides for *administrative* purposes. Besides, the present bacteriological investigation is probably the first one of its kind in India, and further research would be necessary in other parts of India before a definite standard can be arrived at. In the meantime, it is suggested that in the light of the results obtained in Bombay, the standard proposed above should be adopted as a provisional measure for Bombay.

THE COMMITTEE ON MILK SUPPLY TO TOWNS IN BOMBAY PRESIDENCY

BY

MEOLCIAN.

The Committee was formed by the Bombay Government to attempt the solution of the problem of how to increase the present supply of milk to meet demands and at the same time keep down the price.

The subject was divided under two heads for discussion and subdivided :—

1 From the consumer's point of view.

2. From the producer's point of view.

From the consumer's point of view :—

(1) What is the effective demand for milk in Indian cities?

(2) Of the whole milk which is produced in or brought into Indian cities what proportion is used in the form of—

(*a*) Whole milk,

(*b*) Ghee, curd and whey,

(*c*) Others?

(3) To what extent can sickness or ill-health amongst children or adults in cities be traced to defective quantity or quality of milk or to milk contamination?

(4) In what proportion is the city supply to milk produced—

(*a*) Inside the cities,

(*b*) Outside the cities?

(5) Is it desirable to exclude milk cattle from city limits, and, if so, why?

(6) Is it desirable and practicable to insist on any standard of purity or cleanliness for milk, and if

so, what standard is to be fixed and what measures taken to secure it?

From the producer's point of view :—

(1) To what extent can milk production for cities be made more profitable?

(*a*) By better breeding,

(*b*) By better feeding,

(*c*) By better housing,

(*d*) By better tending?

(2) How far can profitable results in milk production be obtained by :—

(*a*) *Dairying* on a large scale by individuals or Companies,

(*b*) Co-operative Societies,

(*c*) Location of goalies in one spot?

Remembering that the individual or company which attempts commercial production on a large scale will have to compete with the small producer, who obtains the benefit of free grazing and sets no value on his time :

(3) How far can transport of milk or curd be economically organized so that larger quantities of these articles may be brought into cities by road or rail?

Remembering the great difference between the price of milk in cities and the price of milk in outlying tracts where ghee is habitually produced :

(4) How far can any economic advantage be obtained by public arrangement in cities for cold storage or for pasteurising?

(5) The relative merits of cows and buffaloes as economical milk producers.

This is a fairly heavy programme and well drawn up—

(1) It was fairly well proved that a large percentage of the population did not use milk because it was too expensive. It was also considered that more milk was needed to supply ordinary demands.

(2) It was very difficult to come to any conclusion regarding the use the milk was put to, but appears to be fairly equally distributed between whole milk, curds and ghee.

(3) No definite epidemics could be traced to milk, but that the main cause of illness in this country

was traced by Major Hutchinson (Sanitary Commissioner) to excremental contamination of the soil with indirect contamination of food and water. Milk, he states, may be easily contaminated by the intrusion of dirty matter or by flies. He attributes the high mortality of children in Poona between one and five years old to contaminated water and gave figures to illustrate his point. He had no evidence of any connection of this high mortality from dysentery with bad milk. He had no evidence of bovine tuberculosis in this country. Other members also stated that no evidence of this disease was forthcoming except perhaps a case or two in the extreme north of India and even there the cases were doubtful.

Dr. Joshi regarded the milk supply as very important to infants, and was of opinion that the amount of artificial feeding of infants was considerable. He attributed more importance to its use by older children than Major Hutchinson and doubted whether vegetable oils were good substitutes for milk. He regarded contagion by bad milk as very serious and as causing dysentery and diarrhœa and as calling for legislation. He agreed that boiling would greatly reduce this danger.

Major Glen Liston advocated sterilisation as preferable to pasteurisation on sanitary grounds and thought that in a hot country it would be much cheaper than refrigeration.

Freshly sterilised milk is not altered, and he thought that it would be readily accepted in this country where milk is almost always boiled before use. The committee did not agree to this.

(4) The milk supply was found to be produced in the city in some cases and only half in others, with the balance coming in from surrounding villages.

(5) The committee agreed almost unanimously that cattle should not be kept in cities, particularly in the densely populated areas.

Major Hutchinson said as regards the exclusion of cattle from towns, that his arguments for exclusion were—

(*a*) The more cattle you have in the inhabited area the greater will be the soil contamination from the

excrement. If the stables were well situated and kept scrupulously clean and the dung carefully removed, the danger is minimised; but it is difficult to obtain this degree of care.

(*b*) Cattle are very foul feeders and very partial to human excrement; and in some towns loose cattle habitually feed on the excrement in the latrines if not well fed and cared for.

(*c*) The stabling of cattle in houses is bad for the health of the people. Even if the cattle are stabled round a house yard in the inhabited area, the practice is bad owing to the close proximity of cattle and human beings.

For these reasons it has been suggested that Municipalities should erect stables outside the inhabited area and induce the goalies to take their cattle there.

Dr. Joshi considered cattle stables should be removed outside the inhabited area so far as practicable.

In connection with the proposal to exclude cattle from cities, Mr. Lawrence wished to emphasize the fact that in a city with a good water-supply and good drainage there was no great objection to keeping cattle in the city so long as the area is not densely populated. The committee agreed that Municipalities should have the power to exclude from densely populated areas the cattle of professional milkmen.

(6) The question of standards was a very much debated one.

It was, however, decided eventually that—

Cows' milk should be 3·5 fats and 8·5 other solids.

Buffs'. ,, ,, ,, 5·5 ,, ,, 9·0 ,, ,,

It was suggested that certified milk be arranged for until an Act could be introduced.

It was found that the country was not yet ripe for a bacteriological standard, but certain recommendations to Health Officers were made.

The questions from the producer's point of view were then discussed.

The physical problems of milk production were again considered It was alleged that certain classes of good milk animals were becoming scarcer than they used to be, but the committee were of opinion that while this might apply to particular breeds in a limited

area, for which the recent demand had been large, there was no evidence of general deterioration amongst the good milk animals of the presidency as a whole.

So far as regards breeding, the first thing is to produce pedigree bulls of a good milk strain, and the work must be entrusted to a skilled agency established by Government and controlled by a breeding expert.

So far as the Indian population is concerned what they want is buffaloes' milk. They want cows' milk only in small quantities for children. It is for the fat and other solids that they value the milk, which makes them prefer the buffaloes' milk, but they also prefer the taste of buffaloes' milk.

It has been found in the Civil Dairy that, irrespective of the strength of the milk, the Sindhi cow produces milk more cheaply than the buffalo ; and this is the experience of the military dairies all over the Southern Circle ; though the Poona goalies are said not to find cows as effective as buffaloes even in the limited sense. When, however, it comes to the question of production of butter fat it is found that buffaloes (Surti breed in the Civil Dairy and Delhi breed in the military dairies) will produce it at a far lower cost than Sindhi cows or any other Indian breed of cows. Another point in favour of the buffalo is that she will give two more calves than a cow will. It is, therefore, considered that for the purpose of milk production the buffalo is the animal upon which efforts should be concentrated, and it is likely that efforts to improve the milking capacity of buffaloes will yield more rapid results than would be the case with cows in general, since buffaloes have always been bred for milk and cattle for draught qualities.

The possibility of dual utility animals should not be overlooked, that is, cattle combining good draught qualities with good milking capacity, but it is probable that with such animals the production of good bullocks would be regarded as the most important matter and milk production as secondary, and in view of Hindu sentiment on the subject of hand-feeding calves, it would be difficult under village conditions to combine the production of strong bullocks with the supply of milk until better cattle are produced. The extraordinarily

heavy mortality amongst buffalo calves in the military and civil dairies requires investigation.

There is some evidence to the effect that in the Civil Dairy, Poona, and in other dairies good cattle bought outside tend to deteriorate in the subsequent lactations under the conditions that are found in a large dairy farm, and that their progeny also tend to deteriorate. This is the case both with cows and with buffaloes. It is admitted that the milk value of the bulls used in such dairies is little known, but presumably the bulls used are as good as those in villages, and the fact that the original animals purchased deteriorate in subsequent lactations indicates that the defect is not in the breeding as carried on at these dairies. The feeding is undoubtedly better than is usually found in villages, and the housing more sanitary. This falling off can therefore be attributed to defective tending. It is probable that in any country the small owner who treats his milk animals as "one of the family" will always get better results from it than the large dairy farmer with whom the animal is merely "a business proposition"; but the men usually available for employment in Indian dairies have, as a rule, little knowledge of cattle and they are frequently bad milkers and careless tenders. This constitutes a serious difficulty. An effort should be made to spread a knowledge of correct feeding methods by means of publication.

Questions of milk production were then considered. As regards breeding for milk, Mr. Frost expressed the opinion that at present breeding for milk was very difficult owing to the lack of good bulls of a known milk strain, and that no improvement would be made until pedigree bulls of a milk strain were produced both for buffaloes and for cattle. This matter was one which required continued study and work by an expert.

It was agreed that existing conditions under which milch buffaloes are kept in cities tend to the slaughter of animals who are of greater value for milk production, since they do not get covered when they come in season and in many cases do not come into season owing to unnatural conditions, and therefore are not usually in calf when they go off milk as they ought to be. This was stated to be the case particularly in Bombay city,

where 7,000 buffaloes out of a total of 21,000 were slaughtered annually, *i.e.*, 33 per cent., whereas it would normally be expected that only 10 per cent. would be cast from the herd. Mr. Gonehalli undertook to produce further figures on this point. It was considered that the rules of the Bombay Municipality which prohibit the slaughter of male buffaloes or the import of the flesh of slaughtered animals probably tend to accentuate this difficulty. It was stated, however, that goalies in Bombay kept the best buffaloes, and that there was amongst some of them a regular practice to send back to Gujarat the best of the dry buffaloes; while some dealers from the Deccan made a practice of buying up dry milch buffaloes in Bombay and taking them to the Deccan to get them in milk again It was also considered that a worse feature of keeping buffaloes in cities remote from grazing grounds lay in the general practice of goalies of killing off the buffalo calves by refusing to feed them, since it did not pay to rear them under such conditions.

The agency available for organising the collection and transport of milk from villages to towns was then considered, and it was pointed out that the agencies available were private individuals or companies and co-operative societies; while Municipalities were interested in their milk supply and might well assist in improving it. It was urged that the retailing or even the transport of milk would be a very difficult job for a co operative society, and that if a Municipality took any direct part in such business they would send up the price of the milk It was recognised that great benefits could be obtained by organising milk producers into a co-operative society which would finance the milk production, and arrange for the collection of the milk. How far a co-operative society should go beyond this must depend on the efficiency of its organisation and the alternative agencies, which might exist to put the milk on the market. It was contended that if there was any profit to be made individuals and companies would come forward to undertake this work. Where they did come forward to do it nothing more was required; but in cases where lack of capital to cover the initial cost of starting prevented anyone from taking

up this business a Municipality might well undertake to advance the necessary capital, applying to Government, if necessary, for a loan for the purpose, in accordance with the proposals made by Government.

Mr. Frost estimated that the smallest amount of milk that it would probably pay to collect and pasteurise at one collecting depôt would be 2,000 lbs. a day, and that the cost of the pasteurising plant to deal with this would be about Rs. 2,500 and about Rs. 2,000 for buildings. Methods of treating milk so as to prevent its going bad were then considered. It was considered that when the milk could be put on the market within 4 hours of milking no special treatment was necessary.

Where the time required was somewhat longer, Mr. Spearman advocated water-cooling accompanied by mechanical separation which removes many bacteria, and so increase the life of the milk. Dr. Mann stated that unless the quantity of milk to be handled was very large, the cost of refrigerating was prohibitive. Both the initial cost and the running expenses of this were very high. Major Liston advocated sterilising on sanitary grounds, but the cost of bottling or tinning was stated to be prohibitive, and Prof. Kelkar stated that sterilised milk would not find a ready market for ordinary purposes, since it had a peculiar flavour if used fresh, and was not suitable for preparing curd or butter.

Pasteurising will give the milk 18 hours' life, and the cost is low. It was pointed out that in other countries pasteurising was advocated on sanitary grounds only in order to kill tuberculosis bacilli, and that apart from this it constituted a danger from a sanitary point of view, for though it prolonged the life of the milk by killing the souring bacteria, these same souring bacteria did much to exclude disease bacteria from the milk. Major Liston stated that pasteurised milk was very liable to re-infection with disease bacteria when it was undergoing the process of water-cooling.

While recognising this possible danger in pasteurising the committee came to the conclusion that pasteurising was the only process which seemed to offer a prospect of commercial success, but expressed the opinion that it was very desirable that experiments

should be undertaken to ascertain the best methods of preserving milk under Indian conditions. It was also suggested that in some places it might be possible to arrange economically with Ice Companies to store milk after it had been brought into a town and until it could be sold.

The committee considered it would be advantageous to press forward the breeding of good bulls and continue using the best available in the meantime. The Veterinary Department are keen on assisting in every way possible and it is evident that more trouble has been taken in the past to provide draught bullocks in preference to milk stock.

The committee agreed that a good milking cow and sire of milking strain were more likely to produce good strong calves than parents that had no milking propensities.

The matter of education in dairying and dairy farming brought out how difficult it was to make any progress until suitable men were trained for assisting co-operative societies, companies, and others. The College at Poona has arranged a course now for any who wish to specialise in this work.

It was also considered necessary that an expert for the province should be appointed. Also that the organising staff for co-operative societies should be strengthened by men with some dairy training.

It is hoped that the full report will soon be issued which will, I am certain, add greatly to the knowledge of the country in this most difficult problem.

It is a great step forward and will give all concerned a basis for greater discussion at the coming Agricultural Board at Pusa where the difficulties of a greater area will have to be discussed.

It is most encouraging to see how great has been the awakening of India to this great and important subject.

The demand for assistance and advice becomes greater, and it is high time Government had a responsible adviser on dairying to advise those now clamouring for information.

NEWS AND NOTES.

SHODDY AS A MANURE.

THE fertilising value of shoddy (*Mark Lane Express* 112 (1914), No. 4339, p. 584). Brief reference is made to experiments carried out at Wye Agricultural College, England, which indicated that Shoddy is a useful and reliable source of nitrogen especially when used in conjunction with, or as a substitute for, barn-yard manure and supplemented with applications of phosphate and potash.

***

JOWAR AS A DROUGHT RESISTER.

The Grain Sorghums, O. O. Churchill and A. H. Wright (*Oklahoma Sta. Bul.* 102 (1914). p. 70, Fig. 31). The Sorghums grew and produced well with 15 per cent. of water in the soil. "This test indicates that Kafir and Milo will grow and produce fair crops when the water content of the soil is too low for the production of corn."

"When two kinds of plants were grown together in the same soil mass, corn died before Oats, Kafir corn and Milo maize and in one case it died before Cowpeas. Kafir corn grown in combination with other crops was in every case the last to die.

***

SILAGE AND BACTERIA.

The optimum temperature for lactic acid bacteria is given as 50° C 122° F. and for butyric acid bacteria 60°. The author prefers the lactic acid silage for dairy cows, as the butyric acid silage has a tendency to taint the milk and butter. In preliminary experiments in inoculating the silage with lactic acid bacteria it was found that such inoculation appears to improve

the keeping qualities of the silage. Although all lactic acid cultures do not act alike, even at a relatively low temperature it is possible to make excellent silage by such inoculation.

*
* *

Food Values.

New method of calculating the production value of feed stuffs for dairy cattle, G Fingerling (*Frühling's Landw. Ztg.* 63 (1914), No. 6, pp. 185-189). The author takes exception to Hansson's proposal (*E. S. R.* 31, p. 371) that Kellner's protein factor of 0·94 be increased in estimating the production value of feeding stuffs for dairy cattle. It is contended that milk production depends largely upon fat and carbohydrate elements rather than protein, and that since Kellner's figure represents production value for body growth it is also suited to milk production. Also since utilisation of protein by the dairy cow will depend upon the lactation period and the producing capacity of the animal, the protein figure will be variable. The author prefers a feed standard on a safe basis and believes that for practical use the Kellner's estimates are the best.

*
* *

Loss by Pasteurisation.

Shrinkage in handling milk at city milk plants (*Cream and Milk Plant* No. 3 (1914), No. 3, p. 22). Estimates were obtained from 41 dealers by the dairy division of the U. S. Department of Agriculture as to the daily losses in the handling and delivery of milk. These estimates which include all losses in handling milk from the time it is shipped, varied from 0·5 to 4 per cent. and averaged 2·15 per cent. of the amount handled by each dealer—loss from not removing all the milk from the pasteuriser, pipes, pumps, tanks, or other apparatus; loss from the process of pasteurising and clarifying, by evaporation and mechanical losses.

*
* *

Key to Successful Farming, J. Kasameier (*Shawnee Okla*, 1913, p. 143, Fig. 69).

In this book the author gives his experiences and describes the methods he used, which were based on

four essentials, *viz.*, preserving the rainfall and moisture, fertilisation, subsoiling, and care of the plant roots. The results of these methods which applied to cotton, corn, potatoes, alfalfa, wheat, oats, tomatoes, sweet potatoes, orchards and forestry are given, with supplemental suggestions.

***

Cure for Mastitis.

Some drugs recently used in veterinary practice.

J. N. Frost (*Coronel Vet.* 4, 1915) No. 4, pp. 190-193).—The author states that during the year four herds in which infectious mastitis was spreading rapidly were treated with methylene blue. Each cow was given 60 grains followed by a dose of 30 grains, the following night and morning. In all cases treated the dose was sufficient to cause the milk to be coloured. Rapid recoveries followed in all the herds without the loss of a single quarter or the production of a hard milker It is stated that one of these herds had been troubled nearly every year by infectious mastitis with the loss of the udder or a section of it and the production of hard milkers by the formation of fibrous growths, commonly called spider in the teat canal.

***

Curing Grass Artificially.

"Curing by artificial heat, using the principle of counter-currents, gives a hay of better colour, odour, and flavour than can be produced by other means. The hay appears to retain many of the valuable properties of the green plant, which are ordinarily lost in curing. The cost of artificial drying is estimated to be less than the losses generally sustained in field curing and, therefore, it ought to be possible to conduct drying at profit when the drier can be located near both field and source of fuel."

***

Report of the Agronomy Department, C. K. McClelland and C. A. Sahr (*Hawaii. Sta. Rpt.*, 1914, pp. 39-42, Pl. 1).

Sudan grass planted November 22nd, 1913, is noted as yielding 31 tons of green forage at the first cutting

March 9th, 1914, and 30 tons at the second cutting, May 8th. Sudan grass seems to be much superior for lower and Tunis grass for higher elevations.

Sudan grass, R. E. Karer (*Oklahoma Sta. Bul.* 103, 1915. pp. 3-14, fig. 3).—This Bulletin describes methods of production of Sudan grass suitable for Oklahoma conditions together with some data on cultural tests. The results of planting on eleven different dates, between April 15th and July 6th, 1914, show early May, from the sixth to the fourteenth, to be the most favourable time to plant Sudan grass for hay.

It will be observed from the data given that the 6-in. rows gave larger yields than the 21-in. and the 42-in. rows gave by far the largest yields. The increase of the 6-in. rows over the 21-in. rows was due to the fact that the crab grass and other weeds grew up on the 21-in. plat and the rows were not of sufficient width to permit the use of the cultivator to keep them down, while the 6-in. rows were close enough together to smother out the majority of the weeds. The 6-in. plats did not come on again after the first cutting was made on account of lack of moisture. The plats of 42-in. rows made two cuttings, which also helps to account for their larger yields.

In testing the proper times to cut Sudan grass for seed production larger yields were obtained by cutting on July 28th than on July 14th, 17th or 22nd, the largest yield being 350 lbs. per acre. Wide spacing between rows, namely, 42-in. produced larger yields of seed than 6-in. spacing.

A table reports analyses of Sudan grass and other forage crops generally grown in Oklahoma. The uses and value of the Sudan grass crop for soiling and silage, pasture, catch crop, rotation crop, and forage are briefly noted.

***

Improving Dairy Cows.

There is a spirit abroad among farmers which is tending to the improvement of our milking cows of all breeds, for the show-yard cow is not one that helps much to pay the rent in the vast majority of instances.

We have been in the past largely judging our cows by inspection alone, and giving the prizes to the pretty animal which most came up to our ideals as far as appearances go, without paying any attention to what she could do at the milk pail. Some years ago the British Dairy Farmers Association instituted two sets of prizes, one for "inspection" and one for milking, according to the tests carried on over two days. This dual system has, of course, simply been an attempt to reconcile the two principles of beauty and milk-yielding power, but has not been quite successful. It is notorious how often the prize winner, judged by appearance, fails in milking power; the proper test of this nature is to combine the two with corresponding scales of marks, and give the first prize to the one gaining the highest total. By this means an ugly cow cannot win, no matter how well she milks, while a useless "beauty" is also cut out. But now the testing of whole herds, and eliminating of the inferior milkers is coming more and more to the front, and the matter was publicly taken up last year by the Highland Society, and a number of dairies tested by way of a start. The actual yield and quality of the milk is tried at regular intervals all round the year or season, and from this the yield is reckoned. The idea underlying this is that, on discovering which are the worst cows, they are to be got rid of, and others introduced, so that the total yield of the herd might be increased. The present writer would like to get some information as to how to get rid of inferior cows. It is a pity to fatten them off for the butcher—and, in fact, it cannot be done if they are in calf and coming round to the work again—while if they are sold they must "do" somebody else, and though the writer likes to get the better of a neighbour when he can, yet there are certain limits to this policy.

***

Increasing the Specific Gravity of Milk.

With the purpose of increasing the specific gravity of milk, German scientists are making some experiments which are likely to prove successful. A recent issue of the *Journal of the Board of Agriculture* contains some information on the subject in which it is

stated that this so-called "thickening" of milk which takes place in the first few hours after milking, and at temperatures under the melting-point of the milk-fat, was first noticed by a French experimenter, Quevenie, about 1841. The present experiments were undertaken to discover the cause of this phenomenon. It was found only to occur at temperatures at which the milk-fat can become firm, and to be undoubtedly due to progressive coagulation of the milk-fat, which is liquid at the time of milking. All other explanations were found to be untenable.

It was shown that the thickening did not take place when the milk was prevented from cooling at temperatures at which fat can coagulate, and it was not discernible in separated milk from which the cream had been quickly skimmed, so that the fat content was very small.

It was evident, by using the polarisation microscope, that the fat in the milk does coagulate in cooling, and the coagulated part has a higher specific gravity than the liquid part. It is well known that pure milk-fat in large quantities changes its state of aggregation at 19 to 24 degs., C., and it is probable that at ordinary temperatures, 12 to 20 degs., C., milk-fat coagulates, both in emulsions and in milk.

This increase in the specific gravity of freshly-drawn milk begins with the cooling under the melting-point of the milk-fat and lasts from 4 to 6 hours. Thereafter the specific gravity of the milk no longer changes at any given temperature. Although it is not probable that all the fat coagulates during this period, the great proportion must do so, otherwise milk, in which the increased specific gravity had reached its limit at average temperatures, would thicken further if exposed to low temperatures for a further period, which according to these experiments it does not do.

*
* *

Pasteurization of Milk in final package

B. W. Hammer and A. J. Hauser (*Iowa Sta. Bul.* 154 (1914), pp. 321-356, fig. 6). In the work reported an effort was made to determine the most

favourable vat temperature and time of exposure for final package pasteurization. The points considered in the determination were bacterial efficiency, creaming ability, and the heated flavour produced.

It was found that "the method of final package pasteurization must be regarded as a modified holding method because of slowness with which the bottled milk can be heated or cooled.

"High pasteurization temperatures are unsatisfactory for the method of final package pasteurization because of the decreased creaming ability and pronounced heated flavour of milk so treated.

"An exposure of 50 minutes in water at 145° F. gave an average bacterial efficiency of 99·56 (13 experiments) and an average creaming ability of 94·68 (20 experiments). The heated flavour developed was so slight that only 8 persons out of 61 detected that the milk had been pasteurized.

"Milk pasteurized in the bottles with an exposure of 50 minutes in water at 140° was very satisfactory from the view point of the consumer. Out of a total of 61 persons, 11 preferred the raw milk, 36 preferred the pasteurized, and 14 saw no difference.

"The intensity of the heated flavour in milk depended to a certain extent on the amount of fat present, inasmuch as the larger quantities of fat tended to mask the heated flavour. Because of the influence of various factors, such as the fat content, and also on account of the variations in the ability of different persons to detect a heated flavour, it is believed to be impossible to make a statement with reference to the exposure necessary to produce this flavour.

"An exposure of 50 minutes at 145° is satisfactory for half pints, pints, or quarts of milk. Exposures satisfactory for milk appear to be satisfactory for cream, if we can judge from the results obtained with pint bottles.

"The exposure of milk to air during the heating process had no detectable influence on either the creaming ability or the detection of a heated flavour.

"Milk pasteurized in bottles by an exposure of 50 minutes in water at a temperature of 145° underwent much the same type of fermentation as good raw milk,

although in the former case the appearance of the fermentation was, as would be expected, materially delayed.

"As the vat temperature is increased above 145° the results obtained are progressively less desirable. A vat temperature of 140° is objectionable mainly on account of the long exposure necessary.

"With short exposures at various vat temperatures an increased creaming ability of the milk so treated was frequently observed but, with exposures which would satisfy the requirements regarding bacterial efficiency, such an increase was not observed.

"Final package pasteurization did not decrease undesirable flavours in milk and in some cases seemed to intensify them.

"Cream with a slightly increased acidity is undesirable for final package pasteurization because of the appearance of the heated cream as well as because of the sensation it gives to the tongue.

"A flavour was imparted to the milk by the paper lining of the cap in some cases. This defect has apparently been recognized by the manufacturers and a cap with a parchment paper lining is at present being made."

Experiments on the pasteurizing of milk in the bottles, Weigmann (*Mitt. Deut. Milchw. Ver.* 31 (1914) July, pp. 149-165, Fig. 3). Successful experiments are reported on pasteurizing milk in bottles at from 64 to 66°. C. (147·2 to 150·8° F.) for half hour. The bacteri content was materially decreased and the keeping quality greatly increased. A variety of forms of bacteria were found in raw material, but in the pasteurized product only lactic acid bacteria, isolated bacillus mesentericus, and some few resistant forms were found. The apparatus and method of pasteurizing is described.

REVIEWS.

THE SOILING SYSTEM. By Alan McNeil, New Zealand Dairyman. Price 6*d*.

This brochure is a clear proof that we have over-rated grazing in the past and any one reading this pamphlet will have good proof of this point. It is not a new theory as may be seen from Fream's "Complete Grazier," but it has only recently been brought more definitely to notice especially in the colonies where farmers are less conservative.

***

THE VALUATION OF FEEDING STUFFS BY MEANS OF CHEMICAL ANALYSIS. By Alfred Smetham, Roy Lane Agri. Society. Price 1*s*.

The author has succeeded in putting into 32 pages the essence of correct feeding principles, and farmers who cannot afford to buy "Kellner" and Henry "Wolff" have the information they need for one shilling in such language and so clearly stated that none need dispair to understand this important subject.

***

SOIL VENTILATION. By A. Howard and Gabrielle Howard. Price As. 4. Govt. publication.

It is important that the matter treated in this Bulletin be understood by all farmers. It illustrates how easily a farmer may fail notwithstanding ample water, good land, and every other advantage. Every farmer knew that the moving of the soil and incorporation of humus was an advantage but seldom knew why.

SCIENCE OF DAIRYING. By W. A. G. Penlington. Cost half a Crown. Macmillan and Co.

This work has been specially designed for use in schools. It is complete in detail without being prolix. Each chapter ends with a series of best questions, the answering of which demonstrates that the author's tuition has been assimilated.

Every student of problems has felt at times the irony of being left in the dark by a book which left out details of information because of the assumption that the reader would be sure to know.

LIST OF MEMBERS OF DAIRY EDUCATION ASSOCIATION, INDIAN BRANCH.

Abhyankar, I. S., Agriculture College, Poona.
Algar, A., Manager, Government Military Dairy, Lucknow.
Allan, R. G., M A., Principal, Agriculture College, Nagpur, C. P.
Athalye, M. G., Agri. Inspector, Sangli State.
Bee, R., Manager, Keventer Dairy Farm, Tara Devi, Simla.
Betts, W., Manager, Government Dairy, Karnal.
Bomanjee, K. R., I.C.S, Dewan of Cambay, Cambay.
Bostrom, W., Dairy Farm, Aligarh, N. D.
Briddes, F. S., Manager, Govt. Farm, Mooltan.
Bruen, Ewd. J., 7th Class Manager, Dairy, Kirkee.
Case, B C., B.SC., Henzada, Burma.
Chadwick, D. T., I.C.S., Director of Agriculture, Madras.
Chakravarty, I. W., Department of Agriculture, Rangpur, Bengal.
Claney, H. H., Govt. Military Dairy Farm, Peshawar.
Clark, W., Aligarh Dairy, Cashmere Gate, Delhi.
Claxton, Manager, Govt. Dairy Farm, Sabathu, Punjab.
Clouston, D., M.A., B.SC., Director of Agri., Nagpur, C. P.
Crawford, F L. B., Actg. Pclitical Agent, Raipur, C. P.
Crosthwaite, A. R., Registrar, Co-operative Societies, Jubbulpore.
Donald, J., N.D.D., Government Dairy Farm, Peshawar.
Dubash, K. M., F.R.C.S., Charney Road, Bombay.
Duff, C., Manager, Govt. Dairy, Bombay.
Fremantle, A. W., Principal of Agriculture College, Cawnpore.

Frost, G. H., Officiating Assistant Director of Dairy Farms, S. C., Poona.
Ghare, B. K., Agricultural Lecturer, Nawabganj, Cawnpore.
Gill, —, Manager, Government Dairy Farm, Kasauli
Gilling, H. T., Shahjahanpur, Punjab.
Gokhale, R. T., Superintendent, College Farm, Poona.
Gonehalli, V. H., M.A. (Camb.), N.D.D.A., Asst. Registrar, Co-operative Societies, Konkan Division, Ratnagiri.
Gregory, A. A., Manager, Govt. Farm, Jullundur, Punjab.
Griffin, Don., B.SC., Agri. Dept., Ewing College, Allahabad.
Hallowes, F. W., Lieutenant-Colonel, Director of Farms, Army Headquarters, Simla.
Hanmanti, c/o Registrar, Co-operative Societies, Bombay.
Hari Ram, L.Ag., Landowner, *P. O.* Gangpur, Dist. Lyallpur.
Harvey, R. T., A.D.A., Southern Circle, Nagpur.
Herbon, W. P., Manager, Govt. Military Dairy Farm, Sialkote.
Higginbottom, Sam., Professor, M.A., B.S.A., Department of Agri., Christian College, Allahabad.
Horne, E. W., Government Civil Dairy, Poona.
Hulme, A. M., Manager, Grass Farm, Devlali.
Israel, S. B., Retired Deputy Collector, 25, Civil Line, Poona.
Iyer, Venkuswamy P. S. Krishna Row, Teppakulam Street, Madura.
Jacobson, O., Manager, Keventer Dairy Farm, Aligarh.
Karak Singh, M.A., Asst. Professor, Agriculture College, Lyallpur.
Kartar Singh, L.Ag., Dairy Research Scholar, Punjab.
Keatinge, G., I.C.S., Director of Agriculture, Poona
Kelkar G. K., Rao Saheb, Deputy Director of Agri., Poona.
Keventer, Edw., Proprietor of Dairy Farms, Aligarh, Simla, etc., Aligarh, U. P.
Keventer, W., Aligarh Dairy Farm, Aligarh, U. P.
Knight, J. B., Professor, Agriculture College, Poona.
Knowles, A., Manager, Grass Farm, Meerut.
Lamb, A., Manager, Government Dairy, Aden.

Langley, F. H., Manager, Govt. Dairy Farm, Agra, U. P.

Lawrence, Managing Proprietor, Stafford & Co., Byculla, Bombay.

Lawton, J. W., Manager, Indian Dairy Supply Co., Bombay.

Mahamad Akram Khan, Lambardar, *P. O.* Charsada, Dist. Peshawar.

Manilal, B. Nanavatti, Director of Commerce, Baroda.

Mann, H. H., Professor, D.SC., M.SC., F.I.C., Agricultural Chemist, Govt. of Bombay and Principal of Agri. College, Poona (Chairman).

Marlow, G., Manager, Govt. Military Dairy Farm, Ferozepur.

McSwiney, J., B.A., I.C.S., Director of Agriculture, Assam.

Martin, H., Manager, Government Dairy Farm, Mhow.

Marriot. A. S., Major, Asst. Director, Grass Farms, Lahore Cantonment.

Mehta, P. R., M.R.A C., Superintendent, Land Records, Ahmedabad.

Meik, Donald, B.SC., Agri. Department, Ewing College, Allahabad.

Mellor, Capt., Asst. Director, Grass Farm, 7th Meerut Division, Meerut.

Morley, J. J., Manager, Government Dairy Farm, Allahabad.

Mortenson, Manager, Aligarh Dairy Farm, Aligarh, U. P.

Moulds, F. W., Government Military Dairy, Rawalpindi.

Mukhtar, Nabi, Agriculture Department, Jullundur, City.

Narayandas, Balasaheb, Chief of Ichalkaranji State, Madhavgiri Ugra.

Newman, B. J., Manager, Government Dairy Farm, Cawnpore.

Osborn, R., Manager, Government Central Creamery, Ahmedabad.

Paranjpe, M. A., Agriculture College, Poona.

Patel, R. B., Proprietor, Cantonment Dairy, Wellington.

Patuck, N. H., Bombay Dairy Supply Co., Bombay.

Paton, A. M., Manager, Government Dairy Farm, Bangalore.

Pandit, B. S., Agricultural Department, Thana.
Pownall, J., Manager, Government Farm, Lahore.
Power, W., Government Dairy Farm, Rawalpindi.
Ramaiya, K., L.Ag. (Honors), Manager, Experimental Farm, Hebbal, Bangalore.
Reeves, W., Indian Dairy Supply Co., Nadiyad.
Reddick, H., Manager, Government Dairy Farm, Quetta.
Ritchie, H. J., Offg. Deputy Director of Agriculture, N. C., Jubbulpore.
Robertson-Brown, W., F.R.H.S., Director of Agriculture, Peshawar.
Robson, S., Manager, Military Dairy Farm, Kasauli.
Roberts, W., B.Sc., Professor of Agriculture, Lyallpur, Punjab.
Rose, Manager, Government Farm, Amritsar, Punjab.
Rouse, S. W., Government Dairy Farm, Ruk.
Roy, I. C., L.Ag., Pabna.
Sardar Harcharan Singh, L.Ag., Spring-Field, Kasauli.
Sarkar, Prokash Chandra, 18, Russa Road, Bhowanipur, Calcutta.
Shavade, S. V., B.Sc., Superintendent, The Model Dairy Farm, Talegaum.
Shaw, H. T., Indian Dairy Supply Co., Nadiyad.
Shirgaokar, V. V., B.Ag., Camp, Belgaum.
Shri Ramuw Sastry, High Court Vakil, Madras.
Sitole, M. M., M.R.A.C., Director of Agriculture, Baroda State.
Skelton, C., Engineer, Jodhpur.
Smith, W., Assistant Director of Government Military Dairy Farms, on leave.
Spearman, A. H., Government Dairy Farm, Kirkee.
Stanford, T. I., Manager, Government Dairy Farm, Dagshai.
Takle, I. V., Agri. College Dairy, Nagpur, C. P.
Thorne, W. A., Manager, Govt. Dairy Farm, Jullundur.
Tamhane, S. M., Agriculture College, Poona.
Traynor, F. E., Manager, Government Dairy Farm, Belgaum.
Walker, G. K., Major, C.I.E., F.R.C.V.S., Superintendent, C. V. Department, Bombay Presidency, Poona.
Walker, A. M., Manager, Government Military Farm, Dagshai, Simla.

Wells, H. G., Government Dairy Farm, Jubbulpore.
Wynne Sayer, B.A., Asst. Agricultural Adviser to Government of India, Pusa.
Yuill, A. F., Manager, Ind. Cotton Oil Co., Navsari.

***

List of Associate Members in India.

Baroda Sundar Pal, Manager, Nawab's Estate, Comilla.
Byramjee, Pestamjee, Nagpur, C. P.
Chandwarkar, G. H., Pleader, Chikodi, Belgaum.
Damle, K. G., Rao Saheb, Chairman, General Bank, Akola.
Devijada, Datta, Office of Director of Agriculture, Bengal, Chittagong.
Fyfe, W. S., Engineer, Government Military Dairy Farms.
Garden, J., Student, Government Dairy, Ambala.
Gangulee, N., Shantiniketam, Agra Farm, Belpur, E. I. Ry.
Girish Chandra, Kishoreganj, Mymensingh.
Gosh, B., Raja's Lane, Harrison Road, Calcutta.
Jayaji Protap, Moti Mahal, Gwalior, C. P.
Kin, Marnag Tin, Parson's Road, Henzada, Burma.
Laxmi Ratan, R. V., Merchant and Agent, 316, Thambuchetty Street, Madras
Marathe, M. B. Hony. Secy, Agricultural Association, Belgaum.
Managing Director, Laxmi Oil Mill Co., Akola.
Maung Po Yin, 3rd Master, Government High School, Henzada, Burma.
Maung Bah, Resident Excise Officer, Henzada, Burma.
Meerza, Bahadur, S. M., Nawab, 60, Elliot Road, Calcutta.
Natabur Mondul, D. L., Millar & Co., Clive Row, Calcutta.
Rao Saheb Pandit Matidin Sukla, Executive Engineer, P. W. D., Berhampur.
Sardari Lall, Accountant, Government Dairy Farm, Rawalpindi.
Zurhanson, I. G., Revd. Father, Senior Chaplain, R. C. Mission, Anand.

Balance Sheet from 1st October 1914 to 30th September 1915.

Particulars.	Amounts. Rs.	As.	P.	Particulars.	Amounts. Rs	As.	P.
To Printing Charges	960	0	0	By Subscription and sale of Journals	503	8	0
Due to Thacker, Spink & Co. (since paid)	185	1	0	Amount due for Subscriptions ...	50	4	0
To Stamps	71	8	0	By Receipts on Account of Advertisements	357	0	0
To Packing and Freight ..	41	15	0				
To Establishments	177	5	4	By Donations	437	4	4
Subscriptions due to Home Committee (since paid)	165	0	0	Balance Debtor	252	13	0
TOTAL ...	1,600	13	4	TOTAL ...	1,600	13	4

G. H. FROST, *Hony. Secretary,*
Dairy Education Association, Indian Branch.

All correspondence regarding the Journal, advertisements, etc., should be sent to the Hon. Secretary, Dairy Education Association, No. 12, Victoria Road, Poona.

This Journal is issued Quarterly, in October, January, April, July.

RATES OF SUBSCRIPTION.

Annual subscription :—

Non-members, including postage ...	Rs. 4-0-0
Members of D. E. A.	Free
Single Copy, including postage ...	Re. 1-0-0

ADVERTISEMENTS.

	Annual.	One issue.
Full page ...	Rs. 20-0-0	Rs. 6-0-0
Half „ ...	„ 13-8-0	„ 4-0-0
Quarter „ ...	„ 7-0-0	„ 2-0-0
6 Lines	„ 3-0-0	Re. 1-0-0

DAIRY EDUCATION ASSOCIATION.

191 .

THE HON. SECRETARY,

DAIRY EDUCATION ASSOCIATION

(INDIAN BRANCH),

POONA.

Dear Sir,

I wish to become a member of the above Association, and if elected agree to promote the welfare of the Association to the best of my ability and to remain liable for my subscription until I shall notify the Hon. Secretary of my resignation. On receipt of your letter advising me of my enrolment as a member, I will forward the yearly subscription of Rs. 3/12/- to the Hon. Secretary (Mr. G. H. Frost, Government Military Dairy Farms, Poona).*

Dairy School or Schools attended and length of time of instruction.

....

....

Dairying Certificate, Diplomas, etc.

....

....

(Signed)..

Mr., Mrs., or Miss, etc.

Permanent Address...

....

* *The Year commences on 1st October.*

Vol. III, Part 2. Quarterly. JANUARY, 1916.

THE JOURNAL OF DAIRYING

AND

DAIRY FARMING IN INDIA

DAIRY EDUCATION ASSOCIATION

D. E. A

Printed by Thacker, Spink & Company, 6, Mangoe Lane, Calcutta, and
Published for the Committee, Dairy Education Association in India

CONTENTS.

THE JOURNAL OF DAIRYING and Dairy Farming in India.

VOL. III.—PART 2.] QUARTERLY [JANUARY, 1916.

EDITORIAL.

REFERENCE to para. 3 of Editorial in our last issue, we have received four protests against an increase and four who argue that it should be increased. As we are entitled to accept the fact that all other members approve, it is considered that the increase to Rs. 5/- is carried. It is, however, proposed to let the present rate stand this year since most of the members have paid already.

* *

It is regretted that some annoyance was caused by the subscriptions being asked for in advance instead of arrears, but it was unfortunately absolutely necessary since several Native members accepted the journals during the past year, and when the V. P. P. issue came along it was carefully refused. The Committee therefore found it wiser to have the first issue of the year refused to save postage and journals.

We have the great pleasure of recording another meeting of the Agricultural Board which has again given great prominence to Dairy Farming and Cattle Breeding.

The resolutions are sound, and we are very glad to see that the "Civil Veterinary Department" have so ably supported the cause.

*
* *

We have great pleasure in announcing that Mr. J. V. Takle has passed the examination for the Indian "National Dairying Diploma." He is the first man to pass. The only candidate who sat last year failed. The questions are produced in this issue for the guidance of future candidates whose attention is drawn to Vol. II, Part I, page 51, *et seq.*

We congratulate Mr. Takle on his success in so drastic an examination. The Examining Board consisted of Dr. Harold H. Mann, D.SC., M.A., F.I.C., etc., assisted by Professor of Veterinary Science; Rao Sahib G. K Kelkar, Professor in Agriculture, and Mr. G. H. Frost, Officiating Assistant Director, Government Military Dairy Farms, Southern Circle.

Mr. Takle obtained 703 marks out of a possible 1,000 or slightly over 70%. Passing marks on aggregate are 65% and not less than 50% in any subject. We hope to publish a facsimile of the Diploma in our next issue.

*
* *

The Association wish to tender their heartiest congratulations to Mr. Wm. Smith, the Founder of the Indian Branch of this Association, on his most marvellous escape from the recent "Persia disaster." He was pinned under a boat which he was attempting to launch, a few seconds before the "Persia" slipped under the waves. He had two ribs broken, but after being sucked down by the ship some distance, he came up to the surface amid dozens of people all dead, except one French lady to whom he pushed a plank, and, seeing an empty boat in the distance, he swam for it and succeeded in getting in; immediately after others got in and then Mr. Smith and others rowed about until every living soul was rescued. He continued rowing for the next 30 hours until picked up by the "Mallow." Mr. Smith has now nearly recovered from his injuries.

Mr. Knight, a Bridge Engineer on the B. B. & C. I. Railway, most heroically succeeded in launching a boat assisted by another passenger ; this Britisher saved 51 persons. It is a pity this fact was not made known, but Mr. Knight would not allow it to be reported.

Mr. Smith testified that everyone, particularly the women, acted with great bravery all through the trying ordeal.

The heeling over of the ship about two minutes after being struck apparently caused many deaths, and the boats were in consequence mixed up with the funnels, masts, cables, etc. The passengers were hurled from the decks and it is feared many First Class passengers were thrown into the Cricket Net which had been put up before tiffin.

* * *

Dr. Joshi's book on "Milk Problem in India" is reviewed in this number and we strongly recommend it to all interested in Dairying and Dairy Farming in India The book will be procurable from Taraporevala and Sons, Bombay.

* * *

The following new Members were elected during the last quarter :—

Mr. D. Mudaly Day, Boarding Master, B. T. N. High School, Mandalay.

Mr. C. Narsing Raju, Dairy Inspector, Experimental Farm, Hebbal, Bangalore

Sub Condr. F. M. Byrne, Manager, Government Military Dairy Farm, Kirkee.

Mr. S. Daniell, L Ag., Asst. Manager, Experimental Farm, Hebbal, Bangalore.

Mr. R. B. Phatak, B Ag., Lecturer, Agricultural College, Nagpur.

Mr. B. S. Bengali, L.Ag., College Farm, Nagpur.

Mr. L. V. Ghate, L.Ag., College Farm, Nagpur.

Mr. J. Garden, Government Dairy, Ambala.

Associate Members—

Mr. J. N. Zutshi, F.R.H S., F.R., B.S.E., Forest Officer, Court of Wards, Morar, C. P.

Ten Members who refused payment last year were removed from the list.

PROCEEDINGS OF THE BOARD OF AGRICULTURE HELD AT PUSA FROM 7TH TO 12TH FEB. 1916

Cattle Breeding and Dairying

The Board have made out a most excellent case. The recurring cost is nearly Rs. 3,00,000, a fairly formidable figure, but this expenditure cannot be reached for years as the military farms will not be in a position to supply bulls for at least four or five years. It will also take two or three years to train men to replace the managers selected for schools and breeding farms Therefore the only actual expenditure possible for a few years is the pay of the Imperial Expert and his office, say Rs. 30,000 a year, and his advice would be invaluable It is therefore hoped that the Government will not delay in making this much needed appointment.

Resolutions on Cattle-breeding and Dairying.

(1) That the Board is of opinion that in order to make satisfactory progress in the development of good breeds of milk cattle in India and in dairying, an Imperial Officer should be appointed with the title of Imperial Dairy Expert, whose principal duties would be—

- (*a*) The control of the cattle-breeding farms and dairy operations contemplated in the scheme.
- (*b*) The supervision of dairy instruction.
- (*c*) The study and improvement of existing dairy methods in the country and the establishment of the industry on a commercial basis.
- (*d*) Generally to advise and assist Local Governments, Provincial Officers, Military Dairy Farms.

They consider that the arrangements proposed and the estimate prepared by the Committee are reasonable and that the holder, once appointed, should not be liable to transfer.

(2) That the Board is of opinion that the offer by the Military authorities of the herds of various breeds of pure breed Indian cows and buffaloes, as well as of the facilities for conducting further breeding work in the Military Dairy Farms is of extreme value, and should be gladly accepted. The Board recommends that advantage should be taken of it as soon as the Imperial Dairy Expert referred to in Resolution No. 1 is appointed.

(3) That the Board approves of the scheme of dairy instruction outlined under section B in the Committee's report, and considers that, if carried out, it will fill the need for trained dairy managers for some years to come.

(4) That the Board is of opinion that the problems of the feeding of live stock, and particularly of dairy stock, in India are such as to require the appointment of a chemist at least for a period of ten years to carry out investigation into the problems indicated under section C in the Committee's report. The Board considers the scheme therein outlined is satisfactory and the expenditure reasonable.

(5) That the Board is of opinion that the whole future of the proposed scheme for the improvement of dairying in India is largely affected by the possibility or otherwise of satisfactory arrangements being made for immunising the cattle against disease. The Board therefore considers that the increase in the Muktesar staff proposed by the Committee for this purpose is reasonable and is essential to the success of the scheme as a whole.

Subject II.

(6) That the Board considers that before any fixed policy is adopted in the various Indian Provinces for the encouragement of the dairy industry an investigation into the existing supply and demand for dairy produce should be instituted by Provincial Governments. Only when such information is available, it will be possible to indicate the lines of action which promise the most complete success.

(7) That the Board re-affirms its conviction that legislation to protect honest traders in dairy produce against unscrupulous adulteration is essential.

(8) That the Board re-affirms the resolution passed at Coimbatore in 1913 with regard to the condition 'or the improvement of cattle in India as found on page 16 of the proceedings, and desires to lay special stress on points three and nine in the report of the Committee then adopted.

REPORT OF COMMITTEE I.

Members:

1. Mr. S. Milligan (Chairman).
2. Dr. H. H. Mann.
3. Capt. J Matson.
4. Mr. W. Smith.
5. Lt.-Col. J. Farmer.
6. Mr. J. A. G Cattell.
7. Mr. K. McLean.
8. Mr. M. M. Mackenzie.
9. Mr. R G. Allan.
10. Mr. R. Branford.
11. Major G. K. Walker.
12. Mr. B. Coventry.
13. Mr. D. Quinlan.
14. Mr R. W. B. C. Wood.
15. Mr. A. McKerral.

Subject XI.—Further consideration of Cattle-Breeding and Dairying in India.

Terms of Reference :—

(i) To examine the scheme for cattle-breeding and dairying as set forth in the Memorandum by the Agricultural Adviser to the Government of India, dated 19th July 1915, and to make recommendations;

(ii) to examine any other schemes, proposals, or aspects before the Board, and to make recommendations.

The Committee discussed the scheme in detail and have the following recommendations to make :—

(i) *The appointment of an Imperial Expert Breeding and Dairying Officer with the*

title of "The Imperial Dairy Expert," whose principal duties would be :—

(*a*) The control of the cattle-breeding farms and dairy operations contemplated in the scheme.

(*b*) The supervision of dairy instruction.

(*c*) The study and improvement of existing dairy methods in the country and the establishment of the industry on a commercial basis ;

(*d*) Generally to advise and assist Local Governments, Provincial Officers, Military Dairy Farms, Municipalities, and Private Institutions on cattle-breeding and dairying organisation, improved methods, the erection of dairies, building plant, marketing, training, etc.

The Committee consider that the appointment should be a permanent one in the sense that the holder should not be liable to transfer.

Cattle-Breeding and Dairying Instruction.

The Committee consider that the offer of help from the Military dairies is of the highest value as offering a substantial foundation for future development.

Mr. Coventry's recommendations are accepted with some slight amendments. The amended scheme now reads as follows :—

A.—*Cattle-Breeding.*

(*a*) The Imperial Expert to have for breeding purposes the use and control of the following herds of pure indigenous strains and with the concurrence of the Director of Military Dairies, powers of re-distribution, and of adding to the herds for the production of indigenous pedigree stock of good milking strains.

Lahore-Ferozepore.—200 pure bred Saniwals giving approximately 60 young bulls a year after three years for distribution in the Punjab.

Lucknow.—150 pure Hariana giving 50 young bulls a year for distribution in the United Provinces

Poona.—120 pure Sindhis giving 40 young bulls per annum for distribution in the Deccan.

Belgaum—100 pure Sindhis giving 30 young bulls for distribution in South Deccan

Umballa.—120 pure Sanivals giving 40 young bulls for distribution in the Punjab and United Provinces.

Jubbulpore—100 Hariana cows giving 30 young bulls for distribution in the Central Provinces.

Quetta-Ruk—120 pure Sindhis giving 40 young bulls for distribution.

No mention is made in the scheme of provision of bulls for Burma, Bengal, Assam, Madras, and Bihar; but it is understood that Military Dairy Farms may shortly be started, one near Calcutta and in Hyderabad (Deccan) from which bulls will be distributed to Bengal and Madras.

(*b*) *Cross-Breeding.*—The Imperial Expert might have at his disposal the two following farms for the purpose of cross-breeding, *viz.*, Umballa and Bangalore. At both of these stations breeding experiments would be carried out in crossing with imported blood with the primary object of increasing the yield of milk. Incidentally an endeavour might be made in the experiment to fix a type of animal suitable for both milk and draft purposes. In this work the Veterinary staff at Muktesar would co-operate in rendering cross-breed cattle immune or resistant to disease. It may be found possible to extend this cross-breeding work to other farms, care being taken that no cross-bred bulls be issued.

(*c*) *Breeding of buffaloes.*—Young selected buffalo bulls of good strain, 3½ years old, to the number of 200 per annum might be supplied from various Military Dairy Farms for distribution.

There would be thus, to commence with, seven herds of pure indigenous strains aggregating 900 head from which an approximate annual return of 300 bulls 3½ years old is estimated for distribution to Provinces. There would also be an estimated return of 200 bull buffaloes for the same purpose. The Military Dairy Farm might be asked to place at the disposal of the Imperial Dairy Expert a certain number of buffalo herds for experimental purposes.

It is further suggested that these bulls and buffaloes should be handed over to Local Governments for distribution. The price to be paid by the Imperial Agricultural Department to Military Department would be the actual cost—reckoning food, housing, labour and actual incidental expenses, but not including administration or management charges, interest on capital, etc.

B.—*Dairy Instruction.*

The question of systematic dairy education with a view to train well-qualified dairy managers should be dealt with in an experimental manner at present, though it is practically certain that in a very few years more complete arrangements will have to be provided, in the light of the experience gained.

Two methods of establishing dairy schools have been recommended, and a school of each pattern, in the opinion of the Committee, should be opened. The first should be established at Poona under the control of the Agricultural College authorities, and should make use of the College staff for scientific and cognate instruction. The practical training would be given at the Military Dairy Farm, Kirkee, where the students would reside For this school it would be necessary to provide a hostel at the Military Dairy Farm, while the additional staff would simply consist of a Farm Manager, resident at the Military Dairy, who would be in charge of the practical dairy training of the students, and a Lecturer.

The second dairy school should be established at Lucknow under arrangements similar to those proposed in Mr. Coventry's Memorandum. It would be independent of any Agricultural College, and, under the

supervision of the Imperial Dairy Expert, would be under the control of the Military Dairy Farm authorities at that place. It would be in charge of a special Farm Manager assisted by a lecturer. A hostel, lecture room, and laboratory would be provided. After some time the success or otherwise of the two types of school could be compared, and further progress made on the lines which could then seem wisest.

The Committee consider that there is sufficient demand for all the men that these two schools would be likely to supply, provided the entries at each are limited to 15 per annum.

The course should be of two years complete in itself and presupposes simply a good general education. It need not be done entirely in these schools or in one place, but may be carried out in part or altogether at other places recognised for the purpose, such as Agricultural Colleges properly equipped, provided a minimum of two years, including vacations, is given to the subject and certain minima of time are devoted to the several parts of the subject. For students who have passed through such course, an examination would be held at the end of the course and a diploma awarded on the result. The general arrangements for this would be made by the Imperial Dairy Expert with such other authorities as may be associated with him.

C.—*The Determination of Food Values and the Digestive Capacity of Indian Farm Animals.*

The employment of a chemist is recommended for—

(*a*) The estimation of the value of Indian feeding stuffs by analysis;

(*b*) the estimation of the digestibility of feeding stuffs;

(*c*) the relative digestive capacity of cattle and buffaloes.

(*d*) practical feeding experiments;

(*e*) the determination of the individual values *ab initio*.

(*a*), (*b*) and (*c*) may be taken up at once at Pusa or at any other suitable place

where the chemist would be posted and where he would be provided with cattle and buffaloes; (*d*) could be carried out at the Military Dairy Farm and at Pusa, while (*e*) might be deferred for the present.

D.—*The Immunisation of Cattle against Disease.*

Owing to the great importance of the proposed breeding operations, the value of the stock involved and the enormous losses which might follow from an outbreak of disease, immunisation of the cattle by inoculation is imperative. It will be necessary to call upon Muktesar to undertake this. It is important that the inoculations should be supervised by an officer belonging to the superior staff, the whole of whose time would be devoted to this particular work. This in effect means the necessity of appointing another officer to the Muktesar staff. An estimate of the cost of this proposal is shown in the Appendix.

E.—*Legislation.*

The Committee are agreed that the need for protective legislation in respect to the purity of dairy produce offered for sale as recommended by the Board of Agriculture at the 1913 meeting (para. 43, page 49 of the Board's Proceedings) is essential, especially in the larger cities

(*II*) *To examine any other Schemes, Proposals, or Aspects before the Board and make Recommendations.*

The Committee consider that the adoption of the above scheme will mean a distinct advance towards organised effort to improve cattle-breeding and dairying in India but realise that the great bulk of the work will of necessity lie with the provinces. As cattle-breeding and the dairy industry are essentially connected from an economic point of view, the Committee recommend that before any fixed policy is adopted by the provinces an investigation into

the existing supply and demand for dairy produce should be instituted by Provincial Governments. The report of the Committee appointed to consider measures for the improvement of the milk supply in large cities in the Bombay Presidency might serve as a useful reference as to the class of information on which schemes could be framed. Until such information is forthcoming the Committee do not consider that they can offer in this connection any advice which would be of any real value.

With regard to the general question of measures for—

(*a*) The protection and amelioration of the existing indigenous cattle-breeding industry, the preservation and multiplication of the existing fine types of Indian cattle, and the organisation and regulation of breeding tracts.

(*b*) The preservation of grazing areas, the improvement of waste areas, and the general question of fodder supply.

The Committee feels that Local Governments have already acquired a mass of information on the subject and are in most cases taking such action as lies within the means at their disposal. Many Departments however have been and are still severely handicapped by the want of sufficient superior staff. It should not be forgotten, however, that a large proportion of the Indian plough cattle are bred within the boundaries of the Native States, and the Committee consider that the importance of improving the stock and developing the industry should be brought to their notice. With regard to general measures which can be recommended to Local Governments and Native States the Committee endorse the findings of the Committee which sat on the subject at Coimbatore in 1913. (These may be found on page 10 of the Proceedings of the Board of Agriculture.)

The Committee desire to lay special stress on points 3 and 9 which refer to the necessity of the establishment of a larger number of cattle-breeding stations and the provision of more men for the work.

APPENDIX.

BUDGET.

An attempt has been made to give below the approximate cost (capital and recurring) of the schemes suggested in the report. It is estimated that the cost would be roughly as follows :—

Capital.

	Rs.
1 Dairy School each with lecture room and laboratory for 40 students at Rs. 9,000	9,000
2 Residences attached to the Dairy School for Farm Managers attached to Dairy Schools at Rs. 10,000 ...	20,000
3 Residences attached to Farm for breeding operations at Rs. 10,000	30,000
2 Hostels attached to Dairy Schools with quarters for lecturers at Rs 22,000	44,000
Furniture for Dairy Schools	5,000
Purchase of buffaloes at Pusa for the Chemist ...	5,000
Residence of Chemist	20,000
Residence of Assistant Bacteriologist at Muktesar ...	22,000
Laboratory and furniture for Chemist	12,000
Cattle sheds and weigh bridge for ditto	3,000
TOTAL ...	1,70,000

Recurring Expenditure.

Imperial Breeding and Dairy Expert.

	Rs.
Pay of Officer Rs. 1,500	18,000
Clerical establishment (5)	5,220
1 (100—10—150), average 137½	
2 (75—5—100) ,, 187½	
2 (40—4—60) ,, 110	
Menials (4) : 1 (10), 3 (8), average 34	408
Travelling allowance	3,000
Contingencies	1,500
TOTAL ...	28,128

Dairy Schools.

	Rs.
2 Farm Managers on a time scale of pay of Rs. 200 rising to Rs. 700 (average 405 plus charge allowance Rs. 50)	10,920
1 Lecturer 250—30—400 (average Rs. 350 plus Hostel allowance Rs. 50)	9,600
Allowance to Farm Staff at 2 Farms ...	2,400
Servants 4 (8)	384
Contingencies	1,000
TOTAL ...	24,304

Breeding.

Additional cost thrown on the following Military ms on account of breeding operations :—

	Rs.
Lahore-Ferozepore	10,500
Lucknow	11,250
Poona	9,000
Belgaum	7,500
Umballa	9,000
Jubbulpore . . .	7,500
Quetta-Ruk . .	10,000
Bangalore (cross-breeding)	2,500
Umballa (cross-breeding)	2,500
Approximate cost of rearing 500 bulls at Rs. 200. (This amount will be recovered by sale of bulls) ...	1,00,000
Extra supervision of 3 Farm Managers for breeding operations on a time scale of Rs. 200 rising to Rs. 700 or average Rs. 405 plus Rs. 50 allowance .	16,380
TOTAL ...	1,86,130

Chemist.

	Rs.
Salary (Rs 900 plus Rs 100 local allowance) .	12,000
2 Assistants (150—10—200) average 366 2/3	4,400
4 Servants : 1 (10), 3 (8), average 34 . ..	408
Travelling allowance	1,000
Contingencies	1,000
Supplies and Services	2,000
Feed and keep of cattle	1,000
TOTAL ...	21,808

2nd Assistant Bacteriologist, Muktesar.

	Rs
Salary (average Rs 995 p. m.)	11,940
2 Veterinary Inspectors (Rs. 100—150) ...	3,600
4 Dressers at Rs. 12 ..	576
2 Peons at Rs 10	240
Travelling allowance .	3,000
Contingencies	500
TOTAL ..	19,256

Abstract of Recurring Expenditure.

	Rs.
Imperial Officer	28,128
Dairy Schools	24,304
Breeding	1,86,130
Chemist	21,808
Assistant Bacteriologist	19,256
TOTAL ...	2,79,626

DAIRY FARM MANAGEMENT IN INDIA.

BY

MEOLCIAN.

Continued from page 178, Vol. II.

VETERINARY SCIENCE.

Animals in Health and Disease. This subject is dealt with in a most concise and illuminating little pamphlet issued by the Royal Agricultural Society of England, cost one shilling. This together with "Home Doctoring of Animals" by Leeney will enable any farmer, with some experience, to get along with little or no trouble and small expense from the Veterinary Surgeon.

India is particularly trying in regard to cattle diseases and the order to send Managers of Government Farms to the Veterinary Laboratory at Muktesar is a most laudatory one. The diseases there are found in every stage and when an intelligent man has had a few weeks' study at that place, he is in a position to diagnose all dangerous diseases and thereby often prevent disasters such as happened in the old days. The Veterinary Department have made enormous advances in checking disease when discovered and it is within the limit of possibility that India may, in the near future, be as advanced as our Western Countries.

It is, however, a fact that, unless careful management and supervision prevails in the Dairy Farm, very serious loss must be experienced. We have of course the great benefit of being practically free from tuberculosis. Moreover, we have the great advantage of having our cattle almost constantly in the open air which is conducive to good health, but to counteract this we have the very much neglected cattle all around us which are constantly attracting or generating disease.

It is hoped that Government will bring in legislation to prevent the introduction of tuberculosis from Europe

and the Colonies. Australia is particularly bad in this respect.

Callaghan's remarks regarding Australia are particularly pertinent for India.

Our Glorious Sunlight.

" When we bear in mind that direct sunlight is one of the greatest of germicides, it will be at once admitted that our farmers possess a purifying influence which is not at the disposal of stock owners in other parts of the world where dairying is a specialised industry ; in Argentina alone do anything like similar conditions, as far as open-air life and sunlight are concerned, prevail. We do not, however, make quite as much use of our glorious sunlight as is possible, and no doubt we shall see in due course dairies erected and so structurally arranged that it will be possible to allow the sunlight to have effect on the floors of the milking bails, calf-houses, piggeries, etc., thus insuring a much higher standard of cleanliness than can possibly be obtained under the conditions which generally exist at present.

Our Lack of Experience.

Whereas we have conditions like these referred to which tend to promote a high standard of health in our dairy herds, still we are at a disadvantage through want of experience in a number of diseases which have been in existence in the old world for a number of years and on which information of a more or less reliable character has been handed down from father to son from time immemorial.

When a new disease occurs in a district, our farmers are generally at a loss how to proceed, and, as a consequence, the disease establishes itself before the dairy farmers actually realise that a malady of a contagious nature has attacked their dairy herds. It was thus with contagious abortion, and it is so to a great extent with contagious mammitis, not to mention other maladies less common, although it may be pointed out that the latter disease is still confined to a few districts.

Symptoms of Illness.

Reference has been made elsewhere to those symptoms which indicate ill-health in our stock, but it can not be pointed out too frequently that any animal showing symptoms of disease should be

IMMEDIATELY ISOLATED

from the rest of the herd. The farmer, who is generally a pretty busy person, may notice an animal out of sorts but will take no action towards obtaining a diagnosis of the trouble until the beast is really ill. It is then frequently too late, not only to save the animal in question, but to prevent the disease being conveyed to others in the herd.

I remember once visiting a farm where an outbreak of pleuro-pneumonia had occurred; the stock manager was not aware that he had the disease in his herd, and he took no precautions against its spread; the consequence being that several animals in one paddock became affected. In addition, there were a few young bulls in another paddock, one of which had been noticed to be off his feed, but no attempt at isolation had been made. Taking the temperature of the young bull in question, I found it to be 104° Fahrenheit; I recommended immediate isolation, and a few days afterwards the animal developed pleuro-pneumonia and died. Had the bull not been isolated, the probability is that the others in the same paddock would have been affected, but fortunately none of them contracted the disease. This is only one instance illustrating the absolute necessity for the isolation of animals showing signs of illness The following are among the symptoms on which action should be taken:—

1. Loss of appetite.
2. Material falling-off in milk yield.
3. A rise in the animal's temperature of one degree or more.
4. Separating itself from the rest of the herd.
5. The occurrence of lameness, especially if not traceable to some trouble in the feet.
6. An enlarged udder, which may be due to contagious mammitis.

7. Any unusual noise in the action of breathing, which may indicate the presence of tuberculosis or even of pleuro-pneumonia.
8. Any unaccountable purging, which may be due to the action of disease germs growing in the system.
9. Any indication showing that a cow has calved prematurely, such as the appearance of the after-birth, coupled with her milk having some of the characteristics of ordinary "beastings."

As a general rule, however, the farmer has to depend on his own knowledge or the knowledge of one of his neighbours in the treatment of his cattle when affected with disease. For this reason it is more necessary that the dairy farmer should have some knowledge of the commoner diseases than it is for a farmer living in any of the older settled and more thickly populated countries. This, however, is not the case; until quite recently cows were not looked upon as sufficiently valuable to warrant any expensive treatment, and I have known valuable animals left to take their chance when disease made its presence felt. Now that cattle have gone up in price, and that very high class dairy cattle are worth nearly as much in this country as they are in England, it behoves the farmer to pay more attention to the ills and ailments of his stock, and to make some study of the causes and means of prevention of the commoner diseases. It is not intended here to deal with disease save from a general field point of view, but it is hoped that this will be the means of arousing more interest in this branch of the industry on the part of our farmers. My advice, however, would be for all those within reach of a *veterinary surgeon to call in his services whenever any serious malady threatens the herd,* and in this manner we might well say that "a stitch in time saves nine," because if the disease is an infectious one, and the veterinary practitioner is called in immediately the first cases occur, he will be able to give the farmer such definite advice as should lead to the saving of the greater portion of his herd from attack. In such diseases as

pleuro-pneumonia, anthrax, black quarter, etc., this is of great importance, because the herd may be suffering for some weeks before the farmer realises the exact nature of the malady, and, after, perhaps, one animal has been the means of transmitting the disease to half the herd. A reliable diagnosis of the disease, when it first enters a herd, succeeded by prompt measures against its spread, may mean the saving of the whole herd, and it is because of this that the advice of any practitioner of note should always be worth to the farmer much more than the fee charged."

There is perhaps no sadder subject for consideration by the "powers that be" than the awful mortality among calves in India. The Bombay Government have had the matter under consideration, but it is of such colossal importance that it should be taken up by the Imperial Government and all the societies interested.

With imported cattle we have the natural deteriorating effect caused by removal from natural conditions, and it is imperative that new blood be imported frequently.

A TABLE OF RELATIVE VALUES OF SOME CONCENTRATED CATTLE FOODS.*

BY

O. T. FAULKNER, B.A. (Cantab.).

In lecturing at the Lyallpur Agricultural College and in connection with the dairy at that College the need has been felt of some means of comparing the values of different Indian cattle foods. This want can only satisfactorily be filled by the results of research similar to those conducted by Kellner and others on the values of European concentrated cattle foods. However, at the suggestion of the Professor of Agriculture, Lyallpur, an attempt has been made to compare the values of Indian foods by using such data as are available. The relative values assigned by experimenters in Europe and America to the various foods depend on determinations of the amount and the digestibility of the valuable constituents in the different foods; on estimates either of the relative values of these several valuable constituents to the animal or of their approximate costs in foods of the given type; and lastly on determinations of the amount of energy apparently spent, and therefore wasted, by the animal in masticating and disintegrating the foods in question. In attempting to arrive at some basis for comparing the values of various foods available in India the only data that seem to be useful are the determinations of the total valuable constituents of Indian foods by Dr. Leather and the values found by European and American experimenters for the digestibilities, etc., of more or less similar foods used in their countries. It is felt that these data are not sufficient to form any basis for the comparison of the bulky fodders available in India. But an attempt has been made to arrive from these data at figures, which may give a rough guide to the relative value to cattle of the various concentrated foods, which are available in India.

This attempt has resulted in the completion of the table given on the next page.

TABLE I.

	1	2	3	4	5	6	7	8	9	10	
	Total oil.	Total Albuminoids.	Total soluble carbohydrates.	Total Fibre.	Digestible oil.	Digestible albuminoids.	Digestible carbohydrate and fibre.	Energy value (starch=100)	"Kellner's value."	Comparative value (starch=100)	Authority for Digestibility figure.
GRAM MEAL. (Cicer Arietinum) ...	4·5	18	58	6·5	3·5	15	58	81·5	95	**80**	Henry—for cow per meal
GUAR MEAL. (Cyamopsis Psoraliodes) ...	3	27·5	48	8	2	22	49·5	77·5	"	**73**	" " " " "
MOTH MEAL. (Phaseolus Aconitefolius)	1	20	60·5	4·5	·5	16·5	60	81·5	"	**77**	" " " " "
MASH MEAL ("URD") (Phaseolus Mungo) ..	1	20·5	60	1	·5	17	58	80·5	"	**77**	" " " " "
MUNG MEAL. (Phaseolus Radiatus)	1	21	60	1	·5	17	58	80·5	"	**77**	" " " " "
COTTON SEED. (Gossypium Herbaceum) ...	18·5	17·5	31	19	16	12	30	81	95	**77**	Kellner.
LINSEED. (Linum usitatissimum) ..	40·5	18	26	5·5	35	16·5	17·5	117	100	**117**	"
BARLEY. (Hordeum vulgare) ...	2	6·5	71·5	1	2	1	68	79	100	**79**	Henry.
MAIZE. (Zea mays) ...	5	9·5	71·5	1·5	4·5	6	69	86·5	100	**86**	Kellner
JUAR. (Andropogon Sorgham)	1	10	72·5	1·5	3	5	62·5	71·5	100	**74**	Henry.
WHEAT BRAN ..	3·5	13	58·5	8·5	2·5	10	14	62	80	**50**	"
COTTON CAKE. (Machine made from undecorticated seed)	6·5	24·5	26·5	25	6	18	17·5	53·5	85	**45**	Kellner.
LINSEED CAKE. (Machine made) ..	8·5	33·5	31·5	8·5	8	29	29·5	84	95	**80**	"
RAPE CAKE ..	10	33	28	11	8	27·5	23	75·5	95	**72**	"

Columns 1 to 4 inclusive are extracted from Dr. Leather's "Average analyses"(*a*) (the figures being given only to the nearest ½ per cent.), except in the case of the last three oil cakes, where Kellner's figures(*b*) are used.

The amounts of valuable digestible constituents (columns 5 to 7) have been calculated by the use of tables of digestibility given either by Kellner or Henry(*c*); the authority in each case is stated in the last column. For the first five grains the figures for the digestibility of the valuable constituents in cowpeas have been used in the absence of any figures relating to these grains which are more or less peculiar to India.

Column 8 gives the starch equivalent of these amounts of valuable digestible constituents. But the method of calculating this is different from either of the methods commonly used in Europe. Two methods are there in vogue. In the first, based on the respective values of these constituents for the production of fat on a bullock, the equivalents used are :—

1 per cent. Digestible Carbohydrate		1 per cent. Starch
1 „ „ Protein	... ·95 or	1 „ „
1 „ „ Oil	... 2·1 or	2·4 „ „

The equivalents more commonly used in England represent an attempt to take into consideration, not only the values of these ingredients to the animal, but also the relative cost of buying them. They are :—

1 per cent. Digestible Carbohydrate	1 per cent. Starch.
1 „ „ Protein	... 2¼ „ „
1 „ „ Oil	... 2¼ „ „

Protein is given a value equal to that of fat on account of the high prices of highly nitrogenous cattle food in England; and because a certain amount of protein is indispensable for the rations of all kinds of stock—an amount which is large in the case of young animals or milking cows.

The first standard appears unsuitable for the present purpose, because cattle in India are very rarely fed for the special purpose of providing beef. The second method appears undesirable for comparing Indian foods: because a consideration of the figures of

valuable digestible constituents in various foods leads to the conclusion that protein is not very dearly bought in Indian cattle foods. For instance gram contains much more protein than barley, the amounts of fat and carbohydrate being much the same; and the relation between ordinary prices of these grains will not suggest that protein is a much more expensive substance than digestible carbohydrate. The equivalents used in the preparation of this table are :—

1 per cent.	Digestible	Carbohydrate	..	1 per cent.	Starch.
1 ,,	,,	Protein	...	1¼ ,,	,,
1 ,,	,,	Fat	...	2¼ ,,	,,

These figures roughly represent the relative values of these constituents for the production of heat or energy in cattle. This, it is suggested, is the best standard for comparing cattle foods in India. It seems obviously to be the best method to use when judging the value of food given to working cattle. Their food is mainly used for the production of energy; and their comparatively small requirements of protein are not likely to be unprovided for in any ordinary ration. The amount of protein necessary for milking cows is much higher. But since, as has been pointed out, this ingredient is not unduly dear in Indian cattle foods there should be little tendency to supply an insufficient quantity of it. Thus there appears to be no need to place a very high value on it when comparing foods, provided that the necessity for giving it in sufficient quantity be not overlooked.

Column 9 gives in round figures the "Kellner's value" for these different foods. "Kellner's value" here means that percentage of the value of the digested constituents, which is found to be used by the animal for useful purposes. These figures have been obtained by Kellner and other workers by comparing the increase of weight actually made by the animal, when given these various foods in addition to a basal maintenance ration, with the increase which would be expected from a consideration of the starch value of the digested constituents (as given here in Col. 8). Thus the figure for linseed is 100: this means that the value of a pound of linseed to a bullock is, as

nearly as can be ascertained, the same as the value of all the oil, protein and carbohydrate, which he can digest from that linseed. But the "Kellner's value" for bran is only 80, because it is found that an animal puts on, as a result of eating a pound of bran, only 80 per cent. of the increase in weight, which he will put on if supplied with as much pure digestible oil, protein and carbohydrate as that pound of bran contains. (It is assumed that the other 20 per cent. of the value of the food, which appears to be lost, is expended by the animal in the mechanical work of chewing and breaking down the bran itself for digestion.) The figure 95 used in this column for gram, guara, mash, moth, and mung is an average of the figures given by Kellner for different kinds of beans, peas, lupines, etc., which vary from 89 to 99. The remainder are approximately the figures which he gives for the same kinds of grain or cakes as obtained by him in Europe.

Column 10, obtained from columns 8 and 9, therefore gives the values of these various foods to cattle, for the production of energy, compared to the value of starch (= 100) for the same purpose, as nearly as can be ascertained from the data available and here used.

Figures so obtained can obviously only represent an attempt to form a rough basis for the comparison of these foods as obtained in India. Especially the figures for gram, guara, mash, etc., must perhaps be regarded practically as guesses, since the results of no digestibility or "Kellner value" tests of these foods are apparently available. Yet, until the results of actual experiments are available, these figures of "Comparative energy values" of these foods may be of use, since the prices of even very similar foods, at different times and places in India, are liable to variations far greater than the probable error in these figures. It is perhaps unnecessary to emphasise the fact that such figures only represent the values of the foods as so much fuel, as it were, to the animal: whilst the practical feeder has also to bear in mind other considerations—such considerations as the necessity of providing palatable and healthful rations, as well as supplying enough protein, especially for milking cows and growing cattle. For instance, rape cake, apparently, from these tables, often a most economical

food, must be used with discretion : whilst bran, though it may be, judging from these figures, very dear, may yet be worth its price on account of its almost medicinal effect.

In Table 2 the respective values of these foods, when gram costs Rs. 2-8 per maund, are given as calculated from this table.

TABLE. 2.

	Rs.	A.	P.
Gram	2	8	0
Guara	2	4	6
Moth	2	6	6
Mash	2	6	6
Mung	2	6	6
Cotton Seed	2	6	6
Linseed	3	10	6
Barley	2	7	6
Maize	2	11	0
Jowar	2	5	0
Wheat Bran	1	9	0
Cotton Cake	1	6	6
Linseed Cake	2	8	0
Rape Cake	2	1	0

REFERENCES TO LITERATURE.

a. Doctor Leather, F.I.C., F.C.S., Agricultural Ledger (India).

b. Kellner, Kellner "Scientific Feeding of Animals," Translation by W. Goodwin.

c. Henry "Foods and Feeding," 1910.

NATIONAL DAIRY DIPLOMA (INDIA).

Questions given at the Examination for the National Dairy Diploma (India), held at Poona on the 20th, 21st, and 22nd of December 1915. These questions are published to assist future candidates.

PRACTICAL AGRICULTURE.

Section 1.

Marks gained 56. Total Marks 100.

Marks.

1. What crops would you grow, when would you sow, and what amount of seed per acre, under the following conditions :— 20

(a) Where you have a good soil and a limited area with an abundance of cattle yard manure and irrigation, say, at Kirkee or in Central Provinces.

(b) Where you have a poor soil and no manure available but an unlimited area and only the monsoon rains or inundation canals.

Show a complete rotation in each case.

2. Describe the operations of preparing land, the implements used, amount of seed, yield per acre, and the approximate cost of producing the following crops, assuming the land to be excellent and ample manure available :— 20

Oats,

Lucerne, and

Maize.

3. What crops would you grow for the following purposes provided you had good land, plenty of manure, and monsoon rains averaging 30 inches :— 20

Silage and green feeding

For dry storage

For stock feeding

SECTION I.—*contd.*

Marks gained 56 Total Marks 100.

Marks.

4. What steps would you take to improve the quality of the grasses, which are extremely coarse and deep rooted, on land newly taken over for permanent grazing grounds for a Young Stock Farm. 15

5. If given 300 acres of undulating arable land close to your Dairy where you could obtain abundance of water for irrigation by pumps, state exactly how you would deal with this area until it was in perfect order for intensive cultivation, and how and where you would make a complete record of such a farm. 20

GENERAL DAIRYING.

SECTION II.

Marks gained 84. Total Marks 100.

Marks.

1. State in detail your procedure, if ordered to start a Dairy Farm in India, to give 2,000 pounds of milk and produce 200 pounds of butter a day; showing the area of arable and grass land you would take up, the breeds or types of stock you would buy, the numbers of each and the districts or country you would purchase them in and their approximate prices. 25

2. Give the chief characteristics of :— 25

(*a*) Two of the best milking cows in India.

(*b*) Two of the best milking buffaloes in India.

(*c*) One of the foreign breeds of milking stock best suited to India.

3. Give four of the best feeds for a concentrated ration for milch stock in India. Also four of the best fodder crops for the same and state in detail your reasons for considering them to be the best. 15

SECTION II.—*contd.*

Marks gained 84. Total Marks 100.

Marks.

4. State in detail the cost of raising a cow calf from birth until 3 years old, assuming it to be weaned at birth, if kept on the Dairy under our present condition the whole period. Also give any suggestion for reducing this cost. 20

5. You have been ordered to take over a farm which has a large herd of animals mostly unprofitable. State how you would effect an improvement in the shortest period. It is assumed that better cattle cannot be purchased in the country. 20

AGRICULTURAL AND DAIRY ENGINEERING.

SECTION III.

Marks gained 50. Total Marks 100.

Marks.

1. You have been ordered to make roads, erect fencing, and plot out a Farm :— 30

(*a*) The roads necessary being 750 yards long, 375 yards of which is for very heavy and 375 yards for very light traffic.

(*b*) The area of land is oblong measuring 300 acres, the short side being 900 yards long. A space of 150 by 150 yards near the centre is to be reserved for farm buildings. Make a sketch of this land to scale showing the length of fencing required to enclose the whole area, the building site and for both sides of the roads; stating the class of fencing you propose using and the total cost of same.

SECTION III.—*contd.*

Marks gained 50. Total Marks 100.

Marks.

Also a section of the road for heavy and another for the light traffic and the approximate cost of making these two lengths of road.

2. Make a site plan to scale for the Dairy Buildings to fit into the area above allotted, assuming that the Dairy is for 100 milch cattle, 100 dry stock, 150 young stock and 60 calves with the other animals, servants' godowns, etc., for a Dairy of the size indicated. 20

3. Give a ground plan of an ideal cattle-shed for India, with a section plan showing the materials used in floor and structure, giving the total cost of such a building in detail. 25

4. Give an Inventory of all the principal machines, implements, etc., with approximate costs for a farm such as is indicated in question 2 showing same under the following headings 25

(*a*) For the land.
(*b*) For irrigation, 300 acres. Lift 40 feet.
(*c*) For Chaffing Shed, silos and cattle sheds.
(*d*) For the Dairy and Cold Store.

AGRICULTURAL CHEMISTRY.

SECTION IV.

Marks gained 60. Total Marks 100.

Marks.

1. Give the most important elements or constituents in the following and show how they may be useful to the farmer :— 20

(*a*) The atmosphere.
(*b*) Liquid manure from a well drained cattle-shed.
(*c*) Pure water.
(*d*) Lime.
(*e*) Wood ashes.

SECTION IV.—*contd.*

Marks gained 60. Total marks 100.

Marks.

2. It is assumed that the following feeding stuffs are bought by a Farm weekly :— 35

Chemical constituents attached.	2	tons	Cotton Seed Meal.
	2	„	Wheat Bran.
	2	„	Gram.
	1	„	Barley.
	1	„	Oats.
	5	„	Mill refractions.
	5	„	Brewers grains (Wet).
	7	„	Karbi or Churi.

This same dairy sells 1,050 gallons of milk, one adult animal and three calves per week.

The whole of the manure both solid and liquid is used on the 300 acres of dairy land which is farmed intensively. State whether the soil loses or gains from continuous cropping, showing approximately which constituents increase and which decrease if any.

3. Give a balanced ration for a cow giving 24 lbs. of milk per day, her weight being 900 lbs. and is stall fed. 30

The following feeds are available :—

Statement of feeding values attached.	Gram 3-12 per 100 lbs. Bran	Rs.	2 14	per 100 lbs.
	Cotton Cake undecorticated	„	2-8	„
	Cotton Seed Meal decorticated	„	3-4	„
	Barley	„	2-14	„
	Karai (Dal Husk) ...	„	1-12	„
	Cotton Seed Hulls ..	„	1-0	„
	Wheat Dust ...	„	0-8	„
	Maize and Sorghum Silage	„	0-5	„
	Oat Hay ...	„	1-0	„
	Bhoosa ...	„	0-10	„
	Green Khasil ...	„	0-4	„

4. Explain the meaning of the following terms :— 15

Alluvium.
Black Cotton Soil.
Acidity of Soil.
Fertility.
Alkalinity.
Secretion.

CHEMICAL CONSTITUENTS IN A 1,000 lbs.

Name of feed.	Total ash.	Potash K_2O.	Soda Na_2O.	Lime CaO.	Magnesia MgO.	Iron Oxide Fe_2O^3.	Sulphuric Acid $S\ O_3$	Phosphoric Acid P_2O_5	Silica SiO_2.	Chlorine Cl.	Nitrogen.
Cotton Seed Meal	66·0	15·8	.	2 9	10·0	0 84	12·2	30·4	5·48	0·03	
Wheat Bran	58 0	15 2	0·4	1 7	9 7	0·34	5 0	26·9	0 26	...	
Gram	15 0	5·7	0 2	0·3	2·3	0·11	3·9	7 1	0·31	0·14	
Barley	25 0	4 8	0·6	0·7	2 2	0·30	3 8	7 9	6·48	0·26	
Oats	32·0	4 8	0 5	12	2·3	0·38	4 7	7·8	12·54	0 30	
Mill refractions	58 0	15·2	0·4	1·7	9·7	0·34	5·0	26·9	0·26	...	
Brewers Grains . ..	37 0	2·0	0·2	5·2	3·7	0·39	...	16·1	12·27	...	
Kirbee or Churi	34 0	10·9	6·5	4·3	2 1	0 71	3·2	3·8	9·10	0·41	
Adult Cattle	..	2·06	...	16 46	0·79	...	...	15·35	...	...	24·64
Calves	...	2·05	...	21·11	0 85	...	...	18·39	...	...	27·45

Feeding Values.

Name of Feed.	Digestible Nutrients.		
	Crude protein.	Carbo Hydrates.	Fat.
Gram	16·8	54·9	1·1
Bran	11·9	42·0	2·5
Cotton Cake undecorticated	18·0	27·3	5·6
Cotton Seed Meal decorticated .	37·6	21·4	9·6
Barley	8·4	65·3	1·6
Karai (Dal Husks) .	9·5	49·9	2·5
Cotton Seed Hulls .	0·3	33·2	1·7
Wheat Dust	9·6	18·2	1·9
Maize and Sorghum Silage	0·1	13·5	0·2
Oat Hay	4·7	36·7	1·7
Bhoosa ...	0·8	35·2	0·4
Green Khasil ...	1·9	10·4	0·3

AGRICULTURAL BOOK-KEEPING.

Section V Account.

Marks gained 76. Total Marks 100

Marks.

1. Name the particular books in which the following transactions might be shown in an ordinary Commercial Set of Accounts for Dairies :— 20

(i) 1 Buffalo died.

(ii) 5 Delivery Churns lost.

(iii) 200 lbs. butter purchased from Ahmedabad Creamery.

(iv) 2 Delivery carts purchased.

(v) 200 mds. Steam Coal purchased.

(vi) 200 lbs. butter sold on credit.

2. What are the ordinary rules for :— 5

(*a*) Depreciating buildings and Dead Stock.

(*b*) Depreciating and appreciating Live Stock.

SECTION V ACCOUNT.—*contd.*

Marks gained 76. Total Marks 100.

Marks

3. Define the rules you would inaugurate 10
for running a **Dairy** with regard to the following :—

(*a*) Budget Provision for Dairy farm in his Circle.
(*b*) Strength of herds.
(*c*) Leases of lands.
(*d*) Construction of buildings.
(*e*) Employment of establishment.
(*f*) Replacement of Dead Stock

4. A refrigerating plant was bought for 5
Rs. 4,897-8-9 on 15th May 1906 : what will be its value on 15th February 1911 after deducting depreciation @ 16% per annum ?

5. What is the usual rate of interest 5
chargeable on Capital, the basis of its calculation, and how far it affects the financial results of a Dairy ?

6. What procedure will you follow in 5
writing off the amounts outstanding in your books which are considered irrecoverable ?

7. (*a*) What rates would you expect to 9
pay for grain and fodder for your stock in the C. P. ?

(*b*) What rules would you make for fixing sale rates of dairy produce ?

8. (*a*) What is a Rough Inward Day 9
Book and what are the books usually posted from this book ?

(*b*) What are the functions of the Goods Returned and Allowance Book ?

9. Name all the books and forms in 22
detail which require to be kept up on a modern Dairy Farm :—

(*a*) Daily.
(*b*) Monthly.
(*c*) Quarterly.
(*d*) Annually.

SECTION V ACCOUNT.—*contd.*

Marks gained 76. Total Marks 100.

Marks.

10. Do you find any necessity for a Cultivation Register, and, if so, what kind of form would you use? 10

VETERINARY SCIENCE.

SECTION VI.

Marks gained 60. Total Marks 100.

Marks.

1. Explain the digestive system of the cow, giving some idea of the chemical changes of food from the manger to the manure heap. 10

2. It has been decided that a herd of half bred Sahniwal and Ayrshire cattle shall not again be bred with pure bred Bulls owing to the loss of immunity from disease. State in detail how you would act so not to lose the advantage gained and still improve your herd. 25

3. State what action you would take on the outbreak of the following diseases and what precautions you would have taken to prevent such outbreaks :— 20

Rinderpest.
Septicæmia Hemorrhagic.
Piroplasmosis Bigmumia (Bovine).
Foot and Mouth disease.
Scours in calves.

4. Give some of the most important points in the management of stock in India to keep them in good health, and improve the quality of the herd. 10

5. State in detail how you would treat cows with the following diseases :— 15

Caked Udder.
Contagious abortion.
Echino Coccus Cysts.

SECTION VI.—*contd.*

Marks gained 60. Total Marks 100.

Marks.

6. Give the diagnosis for the following and show any diseases they may be confused with :— 20

Rinderpest.
Septicæmia Hemorrhagic.

DAIRY TECHNOLOGY.

SECTION VII.

Marks gained 90. Total Marks 100.

Marks

1. Explain the physical changes in milk and cream by :— 20
   - (*a*) Separation.
   - (*b*) Cream ripening.
   - (*c*) Milk souring.

2. How would you treat milk for despatch to an outstation in India, say 200 miles away :— 20
   - (*a*) If it was exposed to continuous and excessive heat :
   - (*b*) If it was exposed to a temperature not exceeding 100°F. but over 75°F.

3. State what you consider is the weakest point on our Dairy Farms in connection with the milk supply. Give any suggestions for improvement of same. 20

4. You have been given 1,000 lbs. of fresh milk testing 6 per cent. fats for butter making. Give in detail the process you would follow until it was made into butter and the outturn of each product. 20

5. Give the characteristics of good butter. 20

REFRIGERATION.

Section VIII

Marks gained 70. Total Marks 100

	Marks
1. Define the meaning of the following terms :—	20

Specific heat.
Latent heat.
British Thermal unit.
Refrigerant.
Prime Mover.
Evaporator.

2. Give the principles on which a refrigerating machine works (Halls) giving in detail the system of brine pipes for a cold store, ice tank, and milk cooler.	50
3. Give an estimate, ground plan and section, with details of materials of a cold store sufficiently large for storing 30,000 lbs. of butter.	30

CHEMISTRY AND BACTERIOLOGY.

Section IX.

Marks gained 64. Total Marks 100.

	Marks.
1. Give the normal specific gravities of the following liquids .—	25

(*a*) Milk Cows.
(*b*) Milk Buffaloes.
(*c*) Separated milk.
(*d*) A mixture of
60 per cent. Buffaloes' milk.
25 per cent. Separated milk.
15 per cent. Water.
(*e*) Cream at 50 per cent. fats.
(*f*) Sulphuric Acid full strength.

2. Give a simple method of testing the fats, solids and water in the following :—	20

Milk.
Cream.
Butter.

SECTION IX.—*contd.*

Marks gained 64. Total Marks 100.

Marks.

3. Define the following terms and state where they are generally found and the approximate percentages where possible :— 10

Casein.
Lactose.
Lactic Acid.
Butyric Acid.
Albumen.

4. Give the chemical constituents of :— 15

Milk pure.
Butter milk undiluted.
Butter.

5. Give three methods of keeping milk over for indefinite periods, giving the details of any one system and the effect of each operation. 15

6. What is the most universal system of keeping milk for periods up to 3 days. Detail this system, showing the changes, etc., that occur biologically. 15

AN INDIAN DAIRY FARM (NEW STYLE).

BY

REV. HAROLD SHORT.

ONE evening in Bangalore—the garden city of Southern India—we saw a black man modestly dressed in a red loin cloth holding a little can and the lead rope of an angular hump-shouldered cow in one hand, and the drag line of a reluctant calf in the other. The two halted outside a bungalow. The suddenly animated calf started the flow of its mother's milk, and the Indian continued it until the quantity ordered was measured by the can.

From this scheme we judged that the importance of the dairying industry has not been recognised in Bangalore.

Later, we learned that the Government of India, realising the value of a pure milk supply for their troops in India, had established several Military Dairies.

One spreads itself on 63 acres, two miles from Bangalore, with 480 acres of grazing country adjacent for dry stock.

We met Mr. Paton, Manager of this farm, in the city. The next afternoon we "free wheeled" down a hard red road.

Under a sign inscribed Government Military Dairy "Inspection invited" we rode to the left, past a gardened red-roofed homestead, to the steps of a large stone building.

From a room marked Office came the alert well knit figure of the Manager and we were warmly welcomed in.

Through the window just across the drive is seen a field of Jowari, known in Australia as mullut. Beyond that is an experimental area of the well-known Rhodes Grass. It is similar to the Indian jungle grass but of much richer quality. It gives a fresh crop every month and in its first four months here has yielded an aggregate of 15 tons to the acre.

A pair of Mysore bullocks drawing a "Sabul," English plough, nearby, cause the information that Rhodes Grass has given such satisfaction that soon

natives will be hard sowing the whole cultivation area with it. It is to be the sole green feed all the year round. An acre of Lucerne is growing for the benefit of the young calves. Along the borders of the crops is seen the spineless prickly pear. This is spoken of kindly here, for it does not spread itself unduly and the cattle relish a little of it.

Amongst the farther portion of the cultivation a belt of cocoanut palms lend an attractive eastern touch, enhanced by the figures of Indians climbing to the tops with an agility worthy of our remote ancestors. An artificial lake makes, to use an Irishism, a "background" of scenic and practical value. Closer inspection of the cultivated area reveals a very complete system of irrigation which breaks the crippling power of the dry weather. We are told that practically no artificial manures are used in India.

We followed the Manager to where the Cattle-Yards are neatly and strongly laid out. All the buildings are erected and paved with the plentiful Indian granite and roofed with red tiles.

There are the calving pens; the calf-houses with their suspended lumps of rock salt; the milking room 60 feet long with two rows of American stanchions, spaced to leave four feet for each animal.

A soldier is on duty watching the Indian milkers at their work. Milking machines are not used in this land of cheap labour.

We inspected some of the Ayrshire bulls, which are imported from Scotland yearly—13 arriving last year—also a few from Australia.

They have worked a wonderful improvement in the Indian cattle. Crossed with the "Hansi" cow from Delhi, the "Sanawal" from the Punjab or the "Sindi" from Sind District there is an upward result in appearance and Milk production.

The highest price for a country cow is £10 to £20. A half-bred Ayrshire goes for £25 to £40.

On the first cross the unsightly hump on the shoulders of the native cow and the loose hanging flesh from the neck disappear, the horns are shortened and the whole formation of the animal is broadened and deepened. This improvement has been increased to

the third generation. We saw an heifer of 18 months—the oldest of the fourth generation. Its products are awaited with great interest. The crosses have calved at $2\frac{1}{2}$ years, but the country cow knows not the joy of maternity until her fourth year. But the greater value of the cross is shown, of course, in the milk supply.

The following "Comparison Statements" will show the extent of the increase.

The Sanawal-Ayrshire "Jill" has shown the common continued increase with each lactation period—her first giving 7,927 lbs., the second 8,031, while the third is proceeding as shown below. The calf is always taken away or weaned after seven days

APPENDIX "A."

Comparison statement of Yields-Fat.

6 of the best Half-breds.			6 of the best Country-breds.		
No. of Cow.	Yields	Fat.	No. of Cow.	Yields.	Fat.
	lbs.	lbs.		lbs.	lbs.
133	9,450	418 50	18	4,009	200·11
131	7,409	287 48	28	3,858	180·95
138	6,183	248	30	3,710	188·7
141	5,217	245·19	22	3,606	176·4
132	5,377	247·34	31	3,400	170
127	4,495	184·5	36	3,154	158
Total ...	38,131	1631·01	Total ...	21,737	1074·05
Average ...	6355 18	271·83	Average .	3622 83	179 00

6 of the poorest Half-breds.			6 of the poorest Country-breds.		
No of Cow.	Yields.	Fat.	No. of Cow.	Yields.	Fat.
	lbs.	lbs.		lbs.	lbs
290	3,694	166 5	15	1,529	76·45
140	3,628	145·05	7	1,308	62·68
288	3,616	144 66	24	1,233	60·41
135	3,383	137 70	16	1,167	58·35
261	3 349	130·69	21	1,127	52·89
242	2,994	120·00	9	1,047	47·27
Total ...	20,664	844·60	Total ...	7 409	358·03
Average ...	3444	140 76	Average .	1234 83	59·67

In the well-appointed and plentifully stocked Store-rooms we were shown the following Monthly Ration Statement, also the Food analysis.

APPENDICES "B" AND "C."

Statement showing analyses of grain and fodder articles fed to Government Military Dairy Farm Cattle, Bangalore and other farms.

Description of Articles.	Moisture.	Oil.	Albuminoid	Soluble Carbo hydrates.	Woody fibre.	Soluble Mineral Matter.	Sand	Total.	Nitrogen. Total.	Nitrogen. Albuminial	Food Units.	Cost per Unit.
Cotton Seed Meal	7·45	10·17	31·14	37·07	7·41	5·98	0·75	100·0	5·20	4·98	140·3	0-0-6·16
Cotton Seed Hulls	8·68	5·05	5·93	50·06	27·44	2·75	0·09	100·0	1·11	0·95	77·5	0-0-5·22
Cocoanut Oil Cake	11·47	12·35	20·07	42·99	7·12	5·10	1·00	100·0	3·32	3·21	123·0	0-0-4·14
Brewery Grain	8·29	4·49	16·20	70·43	5·27	2·00	1·19	100·0	1·38	1·36	96·9	0-0-4·62
Hay ..	5·65	1·90	4·62	47·53	33·15	7·35	0·00	100·0	·74	.	23·92	0-0-6·5[illegible]
Bran ..	9·13	3·78	12·87	59·64	7·16	4·67	0·21	100·0	2·10	2·23	105·3	0-0-10·78

Ration Statement.

	Cotton Seed Meal.	Cotton Seed Hulls.	Cocoanut Oil Cake.	Bran.	Brewers' Grain.	Dry Fodder.	Green Fodder.	Salt.	
Average for Cows ..	1½ lbs.	3 lbs.	1½ lbs.	2 lbs.	4 lbs.	20 lbs.	or 50 lbs.	2 ozs.	Rock Salt hung up in all Calf Pens and Byres
Young Stock	1 lb.	2 ,,	.	1 lb.		15 ,,	or 30 ,,	2 ..	
Young Calves ..	* 1 ..		.	½ ..	...	...	......	1 oz.	

* Boiled in Sep. Milk at an average of 6 lbs. per head.

There is a herd of 84 buffaloes, the milk of which helps the butter supply. This herd is, however, being steadily decreased in favour of cows.

The Butter Factory is of stone, very commodious and spotlessly clean. But for the dark faces and native clothes of the employees we could imagine ourselves in an Australian Factory.

Two soldiers receive the milk from the yard and superintend its processes.

We noticed a Halls' C O² Freezer, and an "Astra" combined Churn and Butter worker. The cold chambers are large and well stocked; 1,600 lbs. of milk is pasteurized daily. 100 lbs. goes back to the calves. Up to 500 lbs per diem is sent on a 20 hours train journey. During the past 12 months only two complaints on the condition of the milk at its destination have been received—and these during the hottest months in India. 150 lbs. of butter is turned out daily. 1/2 *d.* per lb.—and mainly sold to the soldiers in 2-oz. lumps at 1¾ *d*

Milk is sent out to soldiers and civilians in 16 oz and 32-oz. sealed bottles, at 1½ *d.* per lb This practically removes one of the many dangers to health in India.

It is hoped that the advantages of this Dairy will soon be further extended to the civil community; and that it will also be used as a Government School to teach Indians the Science of Dairying

"THE MILK PROBLEM IN INDIAN CITIES."

BY

DR. LEMUEL L. JOSHI, M.D., B.SC., D.T.M., F.C.S.

A REVIEW.

A BOOK under this title has just been published in Bombay and we have great pleasure in giving a review of it here.

The author after having studied the Milk question in Europe and America has been carrying out a long and careful investigation in this country. His research work on the Bacteriological Examination of Milk in Bombay appeared in our October issue.

The book is well printed and attractively bound It comprises 232 pages, besides illustrations and 31 reproductions of photographs and a large map of India showing the distribution of various breeds of cattle in different parts of India. A Foreword is written by Dr. J. A Turner, C.I.E., M.D., D.P.H., Health Officer, Bombay The book is dedicated to His Excellency Lord Willingdon, the Governor of Bombay, who has taken a most prominent and practical part in this most useful subject.

In the Foreword, Dr Turner says, "the book Dr. Joshi has published will be a welcome addition to the meagre literature on the subject to which the public has had access hitherto, as it deals exhaustively with the many and varied aspects of the milk supply in India. He has made a special study and has summarised the work done in other cities, and the treatise he now lays before the public is a valuable contribution on the subject."

The work is divided into seven chapters.

The first chapter is introductory and the author states as to what constitutes the milk problem in Indian cities. Various aspects of the problem—the economic,

social, sanitary as well as legal—are mentioned. The problem is summarised as follows :—

"*Briefly stated, the problem before us is to study the various phases of the milk question in India and to find out the most scientific, economic, and effective methods for the production and distribution of pure milk to the cities in large quantities and at a moderate price.*"

In the second chapter a description of the principal breeds of Milch Cattle in India is given with photographs of cows and buffaloes. The milk supply of Bombay is described in considerable detail. Mention is also made of the milk supply of Calcutta, Madras, Delhi, Poona, and Ahmedabad.

The author refers to the *deterioration* of Indian Milch Cattle and ascribes it to (1) Lack of scientific breeding; (2) Exportation of the best animals to foreign countries; (3) Removing certain breeds of cattle to other parts of the country where the climatic and other conditions are not suitable for them; (4) Supplying the large cities with thousands of milch cattle, which eventually fall into the hands of the butcher; (5) Occasional famines; (6) Defective feeding and tending; and (7) Neglect of proper rearing of calves. Very useful figures and facts follow. For instance, as regards the slaughter of dry animals in Bombay and Calcutta, it is stated that in 1914-15, about 13,600 buffaloes from the Bombay cattle stables were slaughtered, while in Calcutta, in 1913, about 9,000 cows were killed at the slaughter-house. The neglect of rearing calves of good milch animals is considered to be even a more serious evil than the slaughter of dry animals. At the end of the second chapter a very useful table is given, showing the daily milk-supply and the number of buffaloes and cows in a few typical Indian cities.

The third chapter gives "Chemical Composition of Milk obtained from various sources. Proposed Milk Standards for India, and the extent of Adulteration in Indian Cities." Analytical figures of milk of various breeds of buffaloes and cows in Bombay, Poona, Bangalore, Calcutta, and Lucknow are given. The

figures for Bombay are given in detail and the results discussed fully.

The question of milk standards for India is then discussed. According to the author, "One uniform standard for all India does not appear to be quite feasible, at least at present. It would be best to have *local milk standards* for different parts of India, where similar conditions of climate, breed, fodder, etc., prevail." The following standard is then proposed for Bombay and Western India :—

Proposed Milk Standard (Chemical) for Bombay and Western India.

	Fat per cent		Non-fatty solids per cent	
	Average.	Lowest limit.	Average.	Lowest limit
Buffaloes' Milk ..	6.5 to 8	5.5	9.0 to 10.0	9.0
Cows' Milk ...	4 to 5	3.5	8.5 to 9.0	8.5
"Mixed" Milk	6.0	5.0	9.0	8.5

The figures are discussed at length and scientific and practical reasons are given for arriving at these standards. The question of legalising milk standards is briefly dealt with Considering the fact that the bulk of the public milk supply of most cities in the Bombay Presidency is obtained from buffaloes, and that practically all the milk sold in the market is either "mixed" milk or buffaloes' milk, Dr. Joshi suggests *one uniform standard for all milk* sold in the market as follows:—

"*Milk as is ordinarily obtained in the market, shall be considered genuine if it is found to contain at least five per cent. of fat and not less than eight and a half per cent. of non-fatty solids, provided that the percentage of fat may be allowed up to three and a half only when it is proved to the satisfaction of the court that the sample was one of unmixed cows' milk, the onus of the proof resting with the vendor.*"

The rest of the chapter deals with adulteration and price of milk in various Indian cities. Figures are quoted in detail.

The fourth chapter deals with the bacteriological examination of the Bombay milk supply and the question of bacterial standards for India. This has already appeared in the October Number of the Journal. It embodies the results of laborious research carried on for several years. Summary and conclusions are given at the end of the chapter. One of the most important conclusions of Dr. Joshi's investigations is that "*Tuberculosis is rarely, if at all, conveyed by milk in India.*"

The fifth chapter deals with the "Local conditions, diseases of milch cattle and other factors affecting the composition, character and purity of milk in Bombay and other Indian cities."

The principal factors are classified as follows :—

(1) *Climatic Influences,* e.g., seasonal and daily variations, the effects of weather conditions, etc.

(2) *Conditions relating to the milch cattle :*—(*a*) Heredity and breed ; (*b*) food ; (*c*) housing, tending, etc. ; (*d*) age ; (*e*) period of lactation ; (*f*) diseases of the milch cattle.

(3) *Conditions ascribed to the Gowlees and other milk dealers :*—(*a*) Customs and habits, *e.g.*, methods of milking, etc ; (*b*) communicable diseases, *e.g.*, Tuberculosis, etc., of the milk dealers themselves.

(4) *Miscellaneous Factors* contributing towards contamination of the milk supply during its collection, storage, transportation, and distribution.

(5) *Effects of heat, bacteria, enzymes, etc.*

Bovine tuberculosis and its prevalence in India is then dealt with. Dr. A. Lankester's investigation is also mentioned. It appears that a few cases of bovine tuberculosis have been found at Peshawar, Cawnpore, Ferozepore and Simla. The disease is comparatively rare in this country. It is not known to occur among buffaloes.

The sixth chapter is very important, as it deals with "The relation of milk to the public health, including infant mortality in India, and the 'Biological properties' of milk."

Among the disorders and diseases that may be caused by bad milk are Diphtheria, Rickets, Foot-and-Mouth Disease, Scarlet Fever, Malta Fever (through goats' milk), Milk Sickness (in the U. S. A.), Sore-throat

and Tonsilitis, Typhoid Fever, Gastro-Intestinal Disorders including ordinary Diarrhœa and Dysentery, Epidemic Diarrhœa, Tuberculosis, Cholera and Milk Poisoning (Galactotoxismus). The most important of these that affect us in India are Cholera, Typhoid, Gastro-Intestinal Disorders, different varieties of Diarrhœa and Tuberculosis. With regard to diarrhœal diseases and cholera, statistics are given from several Indian cities.

Infant mortality in India is compared to that of other countries. The causes of infant mortality in Indian cities are then given in tabular form.

Other subjects treated in this chapter are, milk and infant feeding; the importance of breast-feeding; the relative value of pasteurised, boiled and sterilised milk as food for infants: preservatives in milk; the "biological" properties of milk; enzymes in milk and their significance; the author's observations on Catalase in Bombay milk; and Dr. Lane-Claypon's observations on "Immune bodies" in milk.

The seventh chapter is the longest and perhaps the most important, as it relates to *Remedial Measures* for the solution of the milk problem. These are divided into three parts :—

(1) Economic, educational and other general measures.

(2) Sanitary Measures.

(3) Legislative Control.

A summary of the important points in connection with economic and other general measures is thus given by the author :—

1. The scientific breeding of the "dual purpose" animal for India.

2. The establishment of cattle-breeding farms at suitable centres, and the supply of bulls on the premium system or otherwise.

3. Proper feeding according to physiological standards and based upon practical experience.

4. The removal of the city cattle-stables from the crowded areas to the non-residential parts of the city and to the adjoining suburbs.

5. Improvement in the tending of the cattle and better care of the progeny.

6. The provision for a large storage of fodder, both dry and in the form of ensilage.

7. Better irrigation, particularly in some of the districts in the Deccan.

8. The provision of suitable land by Government, on easy terms for dairy-farming and grazing.

9. The organising of facilities for the export of valuable "dry" buffaloes and cows from Bombay, Calcutta and other large cities to suitable grazing districts, and taking other measures for the prevention of the slaughter of such animals.

10. The prevention of exporting the best breeds of Indian milch cattle to foreign countries.

11. The organisation of the city gowlees into co-operative dairy societies, the location of their animals outside the city, wherever practicable, and a gradual transformation of the gowlee into the village cultivator.

12. The erection, by the municipalities, of milch cattle stables and milking sheds (with the necessary provision for water supply and drainage) in the suburbs, which may be rented out to the gowlee and the cultivator at a concession rate.

13. The organisation of co-operative dairy societies of the village cultivators in the districts, which are within easy access of the city and where a large supply of cheap milk is available.

14. Improvement in the present methods of transport of milk, and better facilities for rapid and cheap transit.

15. The establishment of private dairying concerns on a large scale for the purpose of importing and distributing milk according to modern methods and under sanitary conditions.

16. The organisation of a "Dairy Union" in the city for marketing the milk brought in by the various co-operative societies.

17. The construction of milk depôts, cold-storage rooms, etc., in the city.

18. The appointment by Government of dairy experts whose free services would be available to the above organisations.

19. Creating a demand for better milk by educating public opinion by means of lectures, demonstrations, and the press.

20. Educating the gowlee and the agriculturist in modern methods of economic and sanitary milk-production.

21. The establishment of dairy schools and classes in the vernacular, etc., for imparting practical instruction in dairying and dairy farming and the training of milk inspectors.

22. Provision for the training of dairy managers and breeding experts in connection with the agricultural colleges and Government dairies.

23. The holding of milch cattle shows and the exhibition of milk products and dairy appliances in suitable centres from time to time.

The *sanitary measures* are described in detail. They are considered under the following headings:—

1. *Measures relating to the milch cattle, etc., to be applied by the producer at the source of the supply* including housing and milking.

2. *Reforms in the present methods of storage, transit, and distribution of milk.*

3. *Precautions to be taken by the consumer.*

4. *Artificial methods of preservation and purification of milk* (*a*) Refrigeration, etc.: (*b*) Boiling: (*c*) Pasteurisation; and (*d*) Sterilisation by heat and electricity.

5. *Infants' Milk Depots.*

6. "*Certified*" *milk.*

As regards legislative control, the author believes that "the economic, sanitary and other measures for the production and supply of clean and wholesome milk should *precede* legislation." Fourteen objects are mentioned, for which legislation is suggested. Defects in the present legislation are pointed out and certain amendments are proposed regarding the system of Licenses and Municipal bye-laws about milch-cattle stables in Bombay. The present legal provision for the prevention of adulteration of milk in Bombay is discussed

and an improvement is suggested in the existing Act. *Pure* milk is then defined and three grades of milk are suggested by the author for the purpose of effecting a reduction in the price.

The question of milk inspection is dealt with and the author insists on certain qualifications for a *milk inspector*. We are glad to note that among the duties of milk inspectors is mentioned, "instructing the milk dealers and vendors in the sanitary and economic methods of dairying. The duties of a milk inspector are not only to inspect and supervise, but also to *instruct*." As a practical aid to inspection the Score Card system of America is mentioned and its advantages pointed out.

An outline of the practical measures to be applied in the case of Bombay and Calcutta is given and finally, the conclusion is summed up as follows:—

"The organisation of the sanitary production of milk by village cultivators, gowlees and others keeping milch animals under natural conditions; adequate assistance from Government and Municipalities: considerable improvement in the transport of milk to the cities; the establishment of large dairying concerns for the purpose of importing and distributing milk; and complete sanitary control by the Municipality of the entire milk supply of the city seem to afford the best prospects for a satisfactory solution of the milk problem. The agriculturist, the gowlee, the dairyman, the scientist, the practical sanitarian, the economist, and the legislator, individually and jointly, must study the problem thoroughly from various points of view, and work out the most suitable remedial measures. Then alone, by systematic and persistent effort, by broad education and scientific research, by intelligent organisation and co-operation, by efficient sanitary supervision and tactful legislation, would it be possible to bring about a practical solution of the milk problem in Indian cities."

This is the first publication of its kind in India, and it meets a long-felt want for a scientific treatise on Indian milk. The book deals exhaustively and in a practical manner with all the phases of the milk problem and we have no hesitation in recommending it heartily to dairymen, dairy farmers, and managers,

agricultural and veterinary teachers and students, and to all those interested in the milk question. The remedial measures proposed are practical and well adapted to Indian conditions. Dr. Joshi, the author, must be congratulated for treating a very intricate subject in such a clear, thorough, and masterful way, and for putting together within a short compass such a large store of valuable and useful information.

It also comes at a most opportune moment when the whole country is taking a very keen interest in the subject. Dr. Joshi has spent considerable time and energy in gathering together the very scattered and scanty information that existed in this country and has done very much on Chemical and Bacteriological tests covering a considerable period.

NEWS AND NOTES.

Demand for Casein and Sugar of Milk.

Those of our readers who were present at the laying of the foundation stone of the Kaupokonui Factory may remember that the Hon. Thos. Mackenzie, then Minister for Agriculture, and now High Commissioner for the Dominion, in London, made special reference in his speech to the necessity of the profitable utilisation of the by-products of the dairy. Perhaps his remarks have never since given the majority of his auditors one thought, but they have haunted us ever since. At that time we could not see how this profitable utilisation was to be effected, but as we grow older we grow wiser. This little prelude is due to the fact that we have had a most interesting visitor lately whose mission was to find the articles that are manufactured from these same by-products. The visitor was the vice-president and manager of the Union Casein Co., of Philadelphia, Mr. Mone Isaacs. This gentleman's mission to New Zealand was to arrange for the supply of from two to three million pounds of casein per annum, and incidentally a few hundred thousand pounds of sugar of milk. There are, it appears, about three pounds of casein in every hundred pounds of skim-milk, and about three pounds of sugar of milk in each hundred pounds of whey. The casein is worth 2½*d.* per lb. free on board, while the sugar of milk is worth 3*d.* per lb. These two commodities together work out at 16*d.* per 100 lbs. for the skim-milk. Unfortunately there is not an unlimited demand for the sugar of milk, but there is a large demand for casein. The Union Casein Company, for example, can do with from two to three million pounds per annum, and they are now prepared to make contracts for that quantity, and are willing to make contracts for three or five years. Our visitor's health broke down while he was visiting us and he entrusted "The New Zealand Dairyman" with the task of making known his mission. The Company are appointing an attorney in New Zealand; Mr. Wyatt,

Solicitor, Auckland, and his power-of-attorney will be here in about two months. This will put the Casein Company on a war footing in New Zealand, and by the time the documents arrive a number of complete plants will be here. With the plants the company will send their own expert to erect and start them, and to teach the somewhat simple process of manufacture. The price offered for the casein means another two pence per pound for the butter-fat, which will be a very substantial gain to butter factories who choose to take on the proposition that is now submitted to them. A very large number of American and Canadian butter factories have been supplying the Union Casein Company for many years, some as long as ten years without one single break ; so that is pretty conclusive evidence that they have found the casein business a profitable and satisfactory one. Unfortunately, we are at the moment not in a position to say what the plants will cost, but we are authorised to say that the cost will be about half the amount stated in the Departmental pamphlet on casein issued some time ago. All the machinery used by the Company is covered by their own patents, and it will be supplied direct from Philadelphia. In the meantime, we are undertaking a campaign of the dairy factories to give what information we can on the subject. One great advantage of the proposal to be put before the dairy farmers is that small plants will be supplied for the use of those farmers who skim their milk at home, so that they will be on almost the same footing as other dairymen who cart their milk to skimming stations. Factories that run skimming stations will only require a vat at each creamery, the drier and the rest of the plant being at the main factory. It must be remembered that casein as it is required for commercial purpose is not a food product, and therefore very little plant will be necessary at the skimming stations, and this will be of a most inexpensive character. We hope to be able to give some further information on this subject in our next issue, and in the meantime will commence our publicity campaign at Stratford on the 18th inst., and from that place will visit each of the Taranaki factories in turn.

Sugar of Milk.

Sugar of milk is one of the by-products of cheese-making. About three pounds can be recovered from one hundred pounds of whey. If our readers like to work this out on the fifty-four million pounds of milk dealt with by the Kaupokonui Dairy Company last season, they will see that the sugar of milk comes to quite a tidy bunch of money. We rejoice, therefore, to say that we have discovered a market for some of this by-product. We remember some thirty years ago going to a lecture by an expert on the fruit business. This expert was travelling through New Zealand to find what prospect there was of working up an export trade from New Zealand. He had, he said, been out that afternoon to a suburban orchard. The owner. speaking of some very common Japanese plums, had said that they would not pay him unless he got three-pence per pound. The expert said that the actual value of the plums was about a farthing per pound, and he added that the South Australian grape-growers sold their wine grapes at a halfpenny per pound on the farm and made fortunes at the business. And so it is with the sugar of milk. There is a market for a certain quantity. The plant is rather costly, so that small cheese factories, with small intakes of milk, would not be able to entertain a proposal to put in a plant, but such factories as Riverdale and Kaupokouni Joll's and some other large factories, could install the necessary plant easily, and work it at a profit. The price offering is £28 per ton, f. o. b. We have now received a letter from a friend of wide experience in the dairy business. saying that some years ago he had some correspondence with some one in Denmark on the subject of sugar of milk, but that the washing up of the correspondence revealed the rather ugly fact that the gentleman at the other end wanted to sell the plant to the New Zealand factories, and then take a royalty on the output. There is no "fly in the amber" we are exhibiting now, so that big cheese factories that would like to turn every 100 lbs. of whey into ninepence can drop us a line when we shall have pleasure in putting the proposition before them.—*N. Z. Dairyman.*

Best Way For Calf Rearing.

A correspondent writes for information on the subject of calf rearing in the ordinary way—one that seems to be of perennial interest. In one of my notes the natural method of allowing a calf to suck is suggested when milkers are scarce, but where the usual method of hand-rearing is adopted a modern scheme may be outlined. To begin with, the more milk that can be allowed, the better will the calf be. The present writer has tried all sorts of meals and prescriptions, and has reared many calves per annum but has found nothing to do so well as milk. The drawback is that it costs so much, and even at the present summer prices it soon runs up a big bill—so that one must find a cheaper substitute excepting, perhaps, in remote districts where milk is very cheap. The writer's own practice is to feed with, say, three quarts of milk daily at first, and after a few days to get the young animal to begin eating some meal out of a trough as well. The milk is gradually reduced or watered as the calf takes more meal, until it is totally weaned of the milk at a month old, and with the consumption of, say, twenty gallons of milk. Hay or grass is put before it, so that it begins to eat and chew the cud as early as it likes. The meal may be of various composition ; a favourite mixture is a bushel each of linseed-cake meal, ground oats, bran, and some of the molasses preparations on the market. It occurs to the writer that various other things may be added, such as cod liver oil meal, spices, etc., and it would be a good way to utilise some of the calf meals in the market without all the trouble of mixing the water, or boiling, etc., that is necessary : they can lick the stuff raw with the other things and get the milk and water to drink. The point is to keep them growing, to get them on to a meal and hay diet as soon as possible, and to limit the amount of new milk used.—Primrose McConnell in the *Dairy*.

***

Care of Dry Cows.

It is penny wise and pound foolish to allow the dry cows to loose conditions ; it not only weakens their

constitutions and makes them more susceptible to disease, but it also weakens the unborn calf, which might be your future dairy cow.

Alongside of the cessation of stripping, however, another practice has been abandoned, *viz.*, the changing round of the gang of milkers so that each cow is milked by each milker in rotation; every man now sticks to his own lot of cows, and as one cow drops out and another comes in, the lots are kept as equal as possible. As far as the Professor can see, the results to the cows, to the milkers, and to the milk yield are eminently satisfactory; and he for one will not go back to the old system. There is, of course, nothing new in this, for dairy farmers have practised it for a long time, and it is worth the while of others to do likewise.—*Dairyman.*

***

Twelve Lucerne Don'ts.

At a recent meeting of the Massachusetts Board of Agriculture, Prof. A. D. Cromwell of Pennsylvania gave the following "don'ts" for lucerne raisers:—

1. Don't sow on weedy soil.
2. Don't sow on poorly drained soil.
3. Don't sow a large acreage to begin with.
4. Don't say lucerne can't be grown in New Zealand.
5. Don't sow on any but sweet, well-drained soil. Lucerne is a desert plant.
6. Don't sow on any but a well-prepared, well-settled seed bed.
7. Don't fail to give ample inoculation; both seed and soil inoculation are best.
8. Don't pasture the first year, and don't pasture when wet.
9. Don't feed lucerne as you do hay, feed it as you do grain.
10. Don't spend your hard-earned money for protein feeds; grow lucerne, clovers, Canada peas, cowpeas, and soy beans.
11. Don't lose the leaves; they are the best part of the plant Use hay caps.
12. Don't give up. Many prominent lucerne growers succeeded after some failures.

Dried Milk for Infants.

With a view of reducing the annual loss, estimated at £600, incurred by the Battersea Municipal Milk Depôt, the Borough Council have decided to recommend, as an experiment, the sale of dried milk as supplied at the infants' milk depôts at Leicester and Sheffield.

*
* *

Ayrshires in India.

Mr. Wm. Smith, Junr., a son of Mr. Wm. Smith of the Dairy Supply Company, Edinburgh, returns to India this week after a well-earned holiday in this country, extending over several months. Ten years ago Mr. Smith was appointed dairy expert to the Military Department of the Indian Government, his duties consisting principally in going round the different army stations or cantonments and seeing that the milk supply was as perfect as it could be made, and that other classes of dairy produce were also rendered as unobjectionable as possible from a hygienic point of view. The scheme, which was somewhat new at the time, and was largely instituted as an experiment, worked so well that very soon the Indian Government had it mapped out into two zones to correspond with the two great commands in India—the northern and the southern command. Mr. Smith was allocated to the southern command, and for some years has been officially designated Assistant Director of Military Dairy Farms in the division, the whole scheme both north and south being under the general control of the Quartermaster-General for India, a highly-placed officer. The northern command is looked after by a Director in pretty much the same way as the southern command is, and the importance of the new scheme may be judged from the fact that the Indian Government will have under their direct ownership from time to time anything up to 40,000 cows in milk, this being in addition to followers. When the new departure was made, farms were taken over and managed by the Government through its representatives. Cattle were bought and put on at considerable expense, and generally the authorities took into their own hands what had hitherto

been largely done, if done at all, by indifferent private effort. That the scheme has proved a success is admitted on all hands in India. Enteric fever, the great enemy hitherto of the British soldier in that country, has been wonderfully reduced in its ravages and incidence, while the general well-being of the soldier has been vastly improved. Under the new arrangements, he is supplied with the best class of milk and dairy produce at a fixed low price, but in consideration of that, is not allowed to purchase his supplies from outside. He, therefore, runs much less risk than he formerly did of getting tainted or disease-laden supplies.

But important as these matters are from the point of view of the Army and the Empire, what naturally interested us most, in a talk we had the other day with Mr. Smith, was his recital of what they are doing in India in the matter of crossing native cattle with the view of producing good milkers. The native cattle of India are almost entirely of the humped type. They are very useful and docile cattle in the main, but they are not heavy milkers. They, however, yield very well in butter-fat, the average as a rule being about 4½ per cent. The problem set before Mr. Smith and his fellow-workers, therefore, was to find the breed most suitable to cross with these cattle in order to increase quantity, and at the same time not materially reduce the butter-fat yield. The importance of maintaining the butter-fat ratio will be apparent when it is stated that the milk supplied regularly to the Army authorities is expected to average about 5½ per cent. of butter-fat. The way that this is done is to keep attached to each farm a certain number of buffalo cows, and to mix their milk with that of the ordinary cows. The buffalo cow is not a heavy milker, but, like the native Indian cow, she produces a high ratio of butter-fat, the majority indeed giving up to 7½ per cent. A mixture accordingly of two parts cow's milk and one part buffalo's milk usually gives about the desired percentage in the mixed milk. But of course that did not get over the question of increasing the yield of the native cows, and to do this experiments were carried out with Ayrshires, Holsteins, shorthorns, and one or two other milky breeds. It was interesting to hear from Mr. Smith

that of all these the Ayrshires did best. Not only did the imported animals themselves live better than did those of either of the breeds mentioned, but their progeny were generally of a hardier class, while they came consistently more milky. So pleased are the authorities with Ayrshires for this purpose, that they have practically adopted the Ayrshire bull as their crossing animal, some having been imported this year for this purpose alone. We have seen recent photographs of first crosses between Ayrshire bulls and native cows taken on the Government farms in India, and while the animals preserved undoubted indications of their mixed ancestry in slightly dropping ears, and in rather dreamy heads in many cases, they also showed distinct traces of the Ayrshire in their colourings and body formation. Many of the animals are spotted and speckled just as is often seen in a mixed-colour Ayrshire at home, while the drooping quarters of the native cow is nearly always minimised, if it is not entirely eliminated. Mr. Smith is greatly pleased with the result of the cross, and says that already, through its use, it has been possible to increase the average herd yield as compared with the wholly native cow days by something approaching 100 per cent. An interesting feature of the Ayrshire crosses is that there is almost no trace of the hump of the native cow on them. The excrescence seems to disappear at once, while the crosses are very little short of the native cattle in hardiness and ability to stand the often trying heat. Very fair crosses were got from both the shorthorn and the Holstein in some cases, but the former especially were inclined to go to beef, and the latter were greatly affected by the climate, many of the original importations dying before full use could be got of them.

As to management on these Government farms, the general plan is to graze as far as possible and to hand-feed indoors on both fodder and concentrated foods. The former consists almost entirely of hay and silage, both grown by means of irrigation and both fed green. Even oats are grown to some extent for this purpose, but are also cut and fed without being ripened. Each farm is practically self-contained, and the best

proof that the system is supplying a felt want is that now, whenever a new centre or district is opened, a dairy farm for the supply of the garrison follows almost as a matter of course. All the female calves are kept on for milking purposes, while the bull calves are reared until they are about a year old, when they are sold to native cultivators for work oxen. The cow being a sacred animal in India, no killing in the regular sense is followed as in this country. Owing to the development which is taking place in India, both in dairying, agriculture, and industries, cattle values are gradually rising. In Northern India a cow may still be bought at a price equivalent to £9 to £10, but in Southern India the same animal will cost nearly double that price. On the Government farms all the latest dairy implements are in use, including separators, churns, refrigerators, etc. All the milk on the different farms is passed through a refrigerator or almost immediately after it is milked. In this way it is made to keep much longer sweet, while any germs which might conceivably have got into it in the handling process are neutralised, if not altogether destroyed. Butter factories utilise what is not required for immediate consumption, these also being made available to local farmers, who are more and more taking advantage of the facilities provided for them. The whole scheme is one of great interest, and although prejudice dies hard in India as everywhere else, there are indications that it is going, and the good example shown by the Government in this matter has not been without its influence in helping on the change.—*N. B. Agriculturist.*

***

Lord Willingdon on Cattle Breeding in Scinde.

First and foremost I think we may be all agreed that the Karachi cattle are generally accepted as being the best milch cattle in this country, and secondly they are a very popular breed. The exportation of Karachi cattle generally numbers 600 animals a year. So far so good. The grave point, however, is that some of the breeders in the district are disposed to let their best cattle go because they can get high prices for them abroad.

Keeping the Breed Pure.

I admit to a certain extent that this does incline a breeder to part with his best animals in this way, but on the other hand, being loyal citizens of Karachi, you ought and must retain your best pure breed cattle in this country. I am inclined to think that there is only one breeder of Karachi milch cattle in India who is really making a serious endeavour to keep pure his breed and that is the Governor of Bombay—(laughter and applause)—and it would be a disgrace to you if in the future you had to go to Poona to get your stud bulls. Certain suggestions have been made regarding the encouragement that Government might give to the breeding of these cattle. Personally I am not going to say what the Government are likely to do because you must wait until Mr. Lucas, your Commissioner, has gone into the whole question and made a report. I will say this, however, that the Government is very anxious to keep up the breed of Karachi cattle. We believe they are one of the most important assets, from the agricultural point of view, in this part of the country, and I will say on behalf of the Government that any sound or practical suggestion that Mr. Lucas puts forward we are anxious and willing to assist in every possible way.—*The Times of India.*—10-1-16.

***

Methods of Calf Rearing.

The care of the calf in early life is described fully in Leaflet No. 142 (Calf Rearing), and Leaflet No. 272 (Supply of Store Cattle and Slaughter of Young Calves), but the following general recommendations may be given :—

(1) There should be a plentiful supply of clean straw immediately behind the cow for the reception of the calf at birth.

(2) The navel cord should be rubbed at once with an antiseptic, *e.g.*, a lump of "bluestone" (copper sulphate), as a precaution against infection. (Bluestone has the effect of causing the cord quickly to shrivel up.)

(3) The calf should receive the first-drawn milk of the cow—colostrum—the special nutritive and laxative properties of which are irreplaceable.

(4) It is essential to avoid giving too much food at one meal, especially after a fast, *e.g.*, when calves are purchased at a distant market.

(5) For the first three weeks the calf should be fed at least three times daily, with from 3 pts. to 2 qts. of milk at a meal; afterwards two feeds at equal intervals will be sufficient.

(6) All changes in diet should be effected gradually.

(7) All utensils should be kept scrupulously clean and the milk should be fed sweet and as near blood heat (about 101° F.) as possible.

(8) The calves should be housed in comfortable quarters with access to plenty of fresh air and sunshine. A cement floor, however suitable from the sanitary point of view, is too cold unless covered with several inches of peat, moss, or straw litter. A floor formed of either bricks, or earth, or rammed chalk is preferable. No stereotyped set of buildings is required. If the existing buildings are not quite suitable a little adaptation will usually suffice.

(9) A dose of castor oil should be given on the first appearance of digestive trouble. Mild cases may be cured by the addition of a little lime water, or a pinch of bicarbonate of soda, to the milk.

(10) Above all, every effort should be made to secure healthy calves of right type and breeding.

***

Cattle-feeding Districts.

Milk can be used most economically when hand-feeding is practised, but where this is impracticable the cow's own calf and another are put on to suck three times a day. In the intervals between meals they should be kept tied up near the cow or turned loose in an adjoining box. Preferably for the first month or so calves should be tied up; afterwards, when they have developed the power to ruminate and are less likely to suck each other, they may be turned, a few together, in a loose box, and be given some crushed oats or maize,

linseed cake and bran together with some "fingered" roots and well-got hay. At the end of about 4 months the calves may be weaned and, if the weather is suitable, turned out to grass.

Whey is not well adapted for calf-rearing, for the casein as well as the fat of the milk has been removed in the making of the cheese. Calves, however, fed on whole milk for the first month have been found to thrive well subsequently on about 1½ gallons of warmed whey daily, together with crushed oats or maize given dry.

***

Butter-making Farms.

Where butter is made skimmed or separated milk is usually available for calf-rearing, and, in the absence of whole milk, there is no better basis for a calf food. The essential difference between whole milk and separated milk is that the latter has been almost entirely deprived of its butter-fat or cream. In other respects the two are practically identical. In using separated milk therefore, the aim obviously should be to replace as much as possible of the fat removed by another fat possessing similar properties.

Various meals are used as cream substitutes ; of these one of the simplest and most wholesome is ground linseed. Whole linseed and maize meal in the proportion of 7 to 1 are run together through a grinding mill. (The maize meal serves the double purpose of preventing clogging of the mill and checking looseness of the bowels in the calf). The meal is scalded and stirred with boiling water at the rate of 1 qt. of meal to 1 gal. of water : 1 pt. of this porridge is used to 4 pts. of separated milk. The calf dietary for the first six months as above described may be tabulated as follows :—

First week.—Its own mother's milk three times a day, commencing with about 1 qt. and increasing to 2 qts. at each meal by the third day.

Second week.—2 qts. of new milk (not necessarily its own mother's) three times a day.

Third week.—2 pts. of new and 3 pts. of skimmed (or separated) milk, with ½ pt. of linseed porridge or half a tablespoonful of cod-liver oil, three times a day.

Fifth week.—3 qts. of skimmed milk with 1 pt. of linseed porridge, or one tablespoonful of cod-liver oil three times a day, and a little sweet meadow hay.

Ninth week.—Mid-day milk and cream substitute omitted, 5 qts. of separated milk are given morning and evening, a handful of broken linseed cake (6oz.) at mid-day, and hay.

Thirteenth week.—Milk as before, ¾lb. mixed linseed cake and crushed oats, a few pounds pulped swedes (greenmeat in summer) gradually increasing, hay *ad lib.*

Twenty-first week.—Milk as before, 1 lb. of mixed linseed cake and meal, increasing quantities of roots, hay *ad lib.*

Twenty-fourth week.—Evening milk is discontinued.

Twenty-seventh week.—Milk altogether discontinued.

Separated milk should be poured into the calf pail clear of the froth.

In American experiments, very good results have been obtained by feeding meals in the dry condition along with separated milk.

Crushed oats and separated milk appear to make an excellent diet for calves of from 4 to 12 weeks old. In an experiment at the Royal Agricultural Society's Farm at Woburn the calves, up to the age of 3 to 4, weeks, received whole milk about one gallon per head daily on the average and nothing else. Thereafter they were given, in addition to the milk, dry crushed oats as they would eat them, a handful at a time. For the first six days the calves each ate ¼ lb. oats and drank 1¼ gallons of whole milk. The whole milk was then gradually replaced by separated milk and the oats were increased to ½ lb. daily. After 24 days the whole was dropped entirely and 1½ gallons separated milk and 1 lb. oats were given daily. This feeding was continued till the calves

were twelve weeks old. Within a week afterwards milk was given up, but the calves continued to receive oats, together with linseed cake and hay, and were turned out to grass. During the nine weeks of experimental treatment the calves increased in weight at the rate of almost 2 lb. per head per day.

The fact that starch in food is digested only after it has been converted into sugar in its passage through the alimentary tract, probably explains, to some extent, why starchy food, such as oats or maize, gives better results when fed dry than when gulped down with milk. The conversion of starch into sugar is effected largely by the saliva in the mouth, and the more slowly and thoroughly a starchy food such as oats or maize is chewed and mixed with saliva, the greater is the proportion of starch that will be converted into sugar. Of course, in addition to starch, these grains contain quite appreciable quantities of oil and albuminoids. In 1 lb. of oats, however, there is only about 1 oz. of fat, whereas in $1\frac{1}{2}$ gallons of whole milk there should be about 8 oz. It would appear, therefore, that in the feeding of calves, as with other animals, fat, to some extent at least, can be replaced by starch.

Careful attention during weaning is all important. On no account should the calves be allowed to loose condition. If at grass they should be housed early in autumn with a view to preventing Husk or Hoose, and the feeding should be such as to encourage uninterrupted progress.

***

Bull Power to Separate and Pump.

One point in Mr. Beach's management I noticed when in the stable—the cheap power that he uses for separating milk and pumping the water. The herd bull on an old-fashioned treadmill has proved quite efficient hired help for these chores. And there is a secondary good result: "I have never had an ugly bull," the proprietor informed me. "Cross Bulls, I believe are due to lack of exercise."

To Dehorn a Calf.

The most satisfactory way to dehorn a calf is to apply caustic potash. Caustic potash can be obtained at almost any drug store. It usually comes in the form of sticks about the size of a lead pencil. The calf should be treated when one or two days old or as soon as the starting horn can be located.

To dehorn the calf, clip the hair from the spot where the horn is starting. Then wet the end of a stick of caustic potash and rub on the budding horn until a sore spot about the size of a dime is produced. The operation can be hastened by breaking the skin before rubbing on the potash. The calf should not be turned out into the rain immediately after caustic potash has been applied, as it may be washed down into the calf's eyes.

Caustic potash should be handled by wrapping a piece of paper around the stick. It must be kept in a tightly stoppered bottle, or it will absorb water from the air and dissolve.

***

Essays on the Milkman's Best Friend.

This is how the Council School pupil put it:—

"The cow is a good animal. She has two horns and two eyes, and gives milk which is good to drink. She has four legs and eats grass and hay. Some of them are red and they have long tails."

This is how the head teacher says it ought to be put:

"The female of the bovine genus is a beneficent mammal; this ruminant quadruped is possessed of corneous protuberances, projecting from the occiput. Her vision is binocular, and she yields an edible and nutritious lacteal exudation; she is quadrupedal and herbivorous, assimilating her food in both the succulent and exsiccated states; some of them chromatically correspond to the seventh colour of the spectrum, and they are endowed with caudal appendages of exaggerated longitudinality."

List of Half-Bred Cows

On Government Military Dairy Farms, Southern Circle, which have completed one lactation compared with their dams.

No.	Description of Cross.	Average yield per period, lbs.	Average yield of dam, lbs.	Remarks.
	Mhow.			
320	Ayrshire-Scindi ...	3,753	2,327	
358	" " ...	3,755	985	
323	" Saniwal ..	3,001	1,319	
324	" " ...	3,534	795	
326	" " ...	4,599	1,591	
327	" " ...	2,970	1,087	
328	" " ...	4,755	1,765	
351	" " ..	4,098	2,689	
352	" " ...	1,287	1,083	1st calf.
380	" " ..	4,033	1,597	
359	" " ...	1,198	2,000	1st calf
321	" Hissar ..	4,104	2,043	
325	" " ...	4,361	1,228	
329	" " ...	3,312	1,464	
	Average ..	3,482.8	1,569 5	
	Kirkee.			
1	Ayrshire-Scindi ..	4,308	3,229	With 2nd calf given 5,082 and still giving 18½ lbs. daily.
2	" " ...	3,450	3,229	
3	" " ...	4,503	2,260	
4	" " ...	3,364	2,578	
5	" " ...	4,367	1,471	
7	" " ...	2,170	1,076	
8	" " ...	3,311	1,683	
14	" " ..	7,310	2,917	
9	" " ...	4,934	2,148	
13	" " ...	8 506	2,761	
14	" " ...	3,547	1,986	
16	" " ...	7,500	3,268	
26	" " ...	4,575	2,068	
24	" " ...	5,200	1,973	
6	" Hansi ..	4,798	2,734	
	Average ...	4,789·5	2,358 7	

List of half-bred cows, etc.

No.	Description of Cross.	Average yield per period, lbs.	Average yield of dam, lbs.	Remarks.
	Quetta			
1	Shorthorn-Scindi ..	3,342	1,749	
2	,, ,, ..	3,192	1.800	
3	,, ,, ...	3,203	2,140	
4	,, ,, ...	3,562	1.715	
5	,, ,, ...	3 635	1,632	
7	,, ,,	2,799	1,587	
8	,, ,, .	3.553	2 384	
10	,, ,, ...	2 556	2,082	
12	,, ,, .	9,315	1,338	
13	,, ,, ...	2 007	1,194	
14	,, ,, .	4.547	2 006	
15	,, ,, ..	3,033	2,206	
16	,, ,, ...	3,650	2,500	
18	,, ,, ...	4,180	2.088	
19	,, ,, ...	4,190	1 988	
20	,, ,, ...	3,252	1.304	
21	,, ,, .	5.708	1,860	
22	,, ,, ..	3,579	2,254	
31	,, ,, ...	3,056	1,980	
	Average ..	3,813 6	1,887 2	
	Bangalore			
253	Ayrshire-Saniwal ..	3,943	1 767	
282	,, ,, ..	4,103	1,654	
290	,, ,, ..	4,283	1,967	
298	,, ,, ...	3,253	1 680	
243	Shorthorn-Hansi ...	2 800	1 700	
257	,, ,, ...	3,531	1,390	
267	,, ,, .	5,153	1.700	
288	,, ,, ...	3 613	2.000	
293	,, ,, ...	3,653	1.700	
127	Ayrshire Hansi ...	4,123	2,044	
131	,, ,, ...	5,000	1,700	
132	,, ,, ..	5.270	2.110	
133	,, ,, ...	8 489	2,650	
135	,, ,, .	3,355	1,540	
136	,, ,, ..	3,930	1,870	
138	,, ,, ..	4,685	1,088	
139	,, ,, ...	4,859	1 560	
140	,, ,, ...	3.600	2 650	
141	,, ,, ...	5,217	3 841	
241	,, ,, ...	4,614	1.150	
242	,, ,, ...	2 994	1,850	
246	,, ,,	3 991	900	
250	,, ,, ...	4 682	2,500	
261	,, ,, .	3 349	2 500	
262	,, ,, ...	5,385	3,841	
	Average ..	4,080·3	1,859·3	

REVIEWS.

VETERINARY MEDICINE: EPIZOOTIC ABORTION. By S. Stockman. "Jour. Compar. Path. and Ther. 27 (1914), No. 3, pp. 237—246."

It is stated that practically all of the domestic animals can be infected with Bacillus Abortus but that bovine abortion under natural conditions of infection is almost entirely confined to the bovine species. Although an animal of the bovine species may be experimentally or naturally infected with the bovine disease (vibrio of McFadyean and Stockman) it is unusual, so far as experience goes, to find a large number of cases of natural infection in bovine animals due to the vibrio. It appears that abortion in mares is due to members of group of micro-organism totally different from those which usually cause abortion in other species, but as yet the equine disease has not been the subject of such study as the disease in other species.

Serum from an animal affected by Bang's bacillus will cause agglutination of the bovine bacillus, but it will not agglutinate the vibrio. The same is true with the other biological tests. The disease in bovines is essentially of a chronic nature. "Bovine abortion assumes epizootiological characters while the bovine and equine diseases usually occur as enzootics, but this seems to arise more from the trade transactions and method of breeding to which the different species are subjected than from other causes."

"No great accumulation of virulent material occurs in any part of the body with the exception of the pregnant uterus of an affected animal. It follows from this that gross infection of pastures, stables, or cowsheds only takes place just before, during the act of, or subsequent to, abortion." Infective material in the bovine disease may remain virulent for a period of many months outside the body of the living animal, on the pastures or in the cowsheds. The infective material from the uterus of cow is not excreted any considerable

time before the act of abortion. In the ewe, however, a discharge containing vibrios may pass out on to the pastures from the genital organs a few days after infection, and many weeks before the animal is known to be infected. How long an animal which has aborted may remain infective (virulency of the casual microbe in the genital organs) has not been accurately determined. With regard to the cow, a large number of animals have got rid of the infected material from the genital organs from two to three months after the act of abortion.

Artificial immunization was made on several thousand animals. When a casual dose of bacilli was injected subcutaneously into a non-pregnant animal and that animal became pregnant some two months later it did not abort. This finding might, however, be interpreted to mean that although bacilli may still be in the body the organism has become so resistant to them that they cannot flourish even in the pregnant uterus.

The disease is believed to be disseminated in the bovine species by way of the alimentary tract, but it is also theoretically possible that the cow may be infected when served. It seems very doubtful if the pregnant uterus of a non-infected cow can become infected by the bacillus of bovine abortion travelling up to the genital organs from without as the bacillus of Bang is non-mobile. With the ovine disease the genital avenue of infection seems more probable.

For the diagnosis of the disease the complement fixation and agglutination tests give satisfactory results. See also previous notes (E. B. R. 29, p. 481 ; 30, p. 684). "In the application of serological methods to a herd of flock with the object of picking out the infected animals, weight must be given to the same considerations as in the case of the tuberculin test for a similar purpose."

As regards prevention, it is thought that state measures based on effective restrictions on the movements of infected animals would be ruinous to the business of farmers. By the serological methods it would be possible to establish infected cows in a herd, and where trained men are not available for this work or where there are no provisions for isolating infected animals before they abort or calve, an effort should be made to prevent gross infection by the immediate

removal of infective material and by thorough disinfection of barns, etc.

Immunization, however, in addition to the above-mentioned general measures of prevention, is deemed the best method for solving the difficulty. Since trouble was experienced in regard to the transport and injection of large quantities of liquid culture and abscess formations were liable to follow its use, massive cultures are now prepared by growing on potato, meat extract, peptone bouillon, agar containing salt, glucose, and glycerine. To wash the bacilli from the agar contained in ordinary medicine bottles, about 30 c. c. of saline solution is added with a sterile hypodermic syringe. The bottle is shaken violently in order to rub all the bacilli from the agar, which break up into small portions, and the bacillary emulsion obtained in this way is passed through a strainer. Some thousands of animals have been inoculated without abscess formation due to extraneous contaminations during the operations.

" Two kinds of vaccine have been tried : Anti-abortion A, consisting of living bacilli,and Anti-abortion B, consisting of bacilli killed by exposure to a temperature of 56° C., for half-an-hour. Only non-pregnant animals have received A. Only one dose of A was given, and the animals were not put to the bull, except in certain cases by error, for at least two months after inoculation. Anti-abortion B was given to cows already pregnant and a dose (half the growth of a culture bottle) was injected each month up to the sixth month of pregnancy. In both cases only badly infected herds were chosen for the observations. The herds were taken in groups in different parts of the country and a local organization was set up in each case of farmers' societies and veterinarians.

" Over 3,000 inoculations have been carried out, but it has so far been possible to collect and tabulate the completed results in only one or two groups. The trials with vaccines A and B were in most cases carried out on the same farms, and the controls acted as such for both methods." The best results were obtained with vaccine A, although the animals inoculated with vaccine B showed a greater percentage of normal calving than did the controls or non-immunized animals.

Cattle Feeding Experiments in Denmark.—By H. E. Annett (Agricultural Journal, India, 10 (1915), No. 1, pp. 63—75.)

This reviews the general plan of conducting cattle-feeding experiments in Denmark. The experiments are largely co-operative and carried on with considerable care. Feeding trials were begun in 1887 and have been continued to the present time, more than 4,000 cows having been utilized.

The general results of the trials have shown that wheat, corn and bran give much the same results in milk production, while oil meal is slightly better. One pound of wheat, corn, or bran has been found to be equivalent to 0·73 lb. sunflower cake, 0·67 lb. cottonseed cake, 1·2 lb. molasses, 2·5 lbs. hay, 5 lbs. straw, or 10 lbs. mangel wurzels. The experiments have indicated that changes of feed have practically no effect on the chemical composition of either the fat or the milk. Variations in the composition of the milk are caused, to much greater extent, by the individuality of the animal.

Experiments have also been conducted to determine to what extent mangel wurzels can take the place of concentrated feed in the ration. The results indicate that the protein requirements as determined by the Wolff-Lehmaon, Kellner, and other tables, are too high, and that it is possible to substitute during the winter less expensive feeds such as mangels, for expensive feeds such as cottonseed cake, without decreasing the milk yield or endangering the health of the cattle.

***

Feeding Experiments in Denmark with Dairy Cattle.—W. Helms. (Agricultural Gazette, N. S. Wales 26 (1915), No. 1, pp. 41—47, Fig. 1).

The author gives data collected by him during a visit to Denmark. Two lots of six cows each were put out on grass and tethered within large measured circles, and at the end of the day the grass left within the circle was cut and weighed. This method of investigation occupied 14 days.

It was found that the quantity of grass consumed by the cows was about 155 lbs. per head per day. It varied somewhat, not only as between cows but also in the individual cow from day to day. This variation was not entirely dependent on weather conditions, such as wet, cold, or very warm weather, when the consumption was smaller, but also independently of such conditions. The cows consumed about the same quantity whether they were dry or in milk or whether giving smaller or greater milk yield. A reduction in the milk yield took place in time even when the grass was young and fresh.

From these and later trials it is concluded that "feeding with, and on, grass alone, quite apart from the loss sustained by letting the cows themselves decide how much grass to consume, cannot give us the most profitable results with dairy cattle, and even if other fodder be added to the grass feed a loss of nourishing organic matter can hardly be avoided.

"On account of the varying quality of the grass, especially as it gets older and its digestibility alters, it is difficult to recommend any certain fodder composition when grass also is green. The feeding in summer time must be even and based on similar systematic principles to the winter feeding, *viz.*, in proportion to the condition and milk production of the various cows in the various periods between 'in calf' and 'calving.' On no account must the change from paddock feed to stable feed, or *vice versa*, be too sudden."

*
* *

THE MANUFACTURE OF CONDENSED MILK, MILK POWDERS, CASEIN, ETC. Discussion of methods of analysis :— R. T. Mohan (Journal Soc. Chem. Indus. 34 (1915). No. 3, pp. 109—113).

This is a discussion of the analysis of these various products and the factors influencing their composition and quality.

It is said that milk of different seasons will stand different temperatures, fortunately the highest in the summer. The fresh milk varies in composition with the seasons, and hence the concentration also has to be varied

to bring the product up to standard. In June the solids in the fresh milk average 12·68 per cent.; in the condensed milk 25·81; in August 11·75 and 26·01; in November 13·40 and 26 62. It is said that swells, flat sours, and sweet curdling in evaporated milk are due to under-sterilization. Curdiness (other than sour curd) is due to precipitation of the curd as a hard mass under the action of heat on a product of high solids and acidity. The hard grains sometimes found in the bottom of the cans consist of mineral matter, mostly calcium phosphate, precipitated owing to over-concentration.

***

THE DIGESTIBILITY OF MILK AND MEANS OF INCREASING IT.—By L. Gaucher (Bul. Gen. Ther. Med. Et. Chirury, 167 (1914), No. 14, pp. 371—381; Abs. in Zentbi. Biochem. U. Biophys, 17 (1914), Nos. 1—2, pp. 29—30).

In the opinion of the author the difficulty experienced by individuals in digesting cows' milk is due to the coagulation of the casein in the stomach in large masses rather than in finely divided particles. He recommends that entirement of calf or horse serum be added to the milk to secure the formation of a finely divided curd in the stomach, as the casein in this condition passes readily into the intestines for digestion.

***

THE INFLUENCE OF MILK FEEDING ON MORTALITY AND GROWTH, AND ON THE CHARACTER OF THE INTESTINAL FLORA.—By L. F. Rettger (Jour. Expt. Med., 21 (1915), No. 4, pp. 365—388).

This paper reports a larger number of feeding experiments with laboratory animals (chicks and rats), some of which have been previously noted (E. S. R. 33, p. 273).

No difference was observed in the relative value of ordinary sour milk and of the so-called bulgaricus product. The milk and lactose diet exerted a great influence upon the character of the intestinal bacteria in the case of both white rats and chicks which is attributed to the lactose contained in the milk, as other carbohydrates than lactose failed to exert this influence.

"The injection of foreign bacteria, even in large numbers, does not of itself bring about an elimination or displacement of the common intestinal micro-organisms. Vastly more important is the influence of diet, especially milk and lactose. The feeding of Bulgara tablets or other preparations which contain as the supposedly active agent the bacillus of Metchnikoft and Maze, without due regard to the use of milk, can, therefore, be of little, if indeed of any value. The beneficial effects which it is claimed have been derived from the use of yoghourt, and other oriental sour milk products have in all probability been due to the milk as much, rather than to the bacteria which they contained."

***

THE GERMICIDAL EFFECT OF LACTIC ACID IN MILK.—By P. G. Helneman (Jour. Infect. Disease, 16 (1915), No. 3, pp. 479—86).

In the experiments here reported samples of sterile milk containing different concentrations of lactic acid were inoculated with Bacillus Coli, B. Dysenteria, B. Typhosus, and B. Paratyphosus. Bacteriological examination of these samples were then made to determine the growth of the organisms.

From the results of these experiments the author concludes that, although resistant strains may survive, the growth of pathogenic bacteria in milk is unlikely in the presence of 0 6 per cent. of lactic acid. "The smaller the initial amount of lactic acid, the more likely is the growth of acid-tolerant strains. Consequently, the slower the milk sours, the greater is the danger of pathogenic bacteria surviving."

***

ZEBU CATTLE IN BRAZIL.—By B. H. Hunnicutt (Jour. Heredity, 6 (1915), No. 5, pp. 195—201, Pl. 1, Fig. 4).

An account of the introduction and development of the Zebu in Brazil. The crosses on the native stock are described as being popular with ranchers, hardy disease-resistant, and fairly good milkers.

ZEBU CROSSES IN TUNISIA.—By M. Hoederer (Jour. Heredity, 6 (1915), No. 5, pp. 201—202).

Zebu crosses with Arab cattle are described as being of good size, good butcher quality, easily kept in condition, hardy, and excellent as draft animals. The Asiatic race of Zebu is preferred for crossing purposes.

***

DIFFICULTIES ENCOUNTERED IN MAKING HIGH-GRADE MILK, and their Practical Solution.—By J. R. Williams (N. Y. Dept. Agri. Bul. 68 (1915), pp. 1021-1032, Pls. 4).

The author reports experiments undertaken to determine the effects of brushing and washing the udder on the bacterial content of the surface of the teats; also to determine the value of disinfectants in the cleaning of the udders. The results, while not conclusive, suggest that "perfunctory washing loosens or frees from the epithelial layers of the teats more bacteria than it removes, so that more germs may be readily removed in the handling of the teat after the washing than before. Washing from a common pail may carry germs from one cow to another as that the process of washing instead of removing may add enormous numbers of germs to the teats. In this way cows with infected udders may be the source of infection for all other cows in the same group.

"Antiseptics apparently reduce the number of visible germs on the teats. It is uncertain, however, whether or not they are destroyed or their growth on the test plate merely inhibited.

"By far the best way to prepare a cow for milking is to wash each udder with a pail of clean water and wipe the teats with a piece of sterile cloth. It is a serious question whether or not any other method of preparation for milking is of value. Unfortunately, this method requires more labour and the extravagant use of water and sterilized cloths."

PROCESS OF STERILIZING MILK AND CREAM.—By A. Rutter (English Patent 216, January 3, 1914, Abs. in Jour. Soc. Chem. Indus. 34 (1915), No. 9, p. 500).

"Milk or cream is treated with from 0·95 to 0·15 per cent. of its weight of an alkali peroxide, *e. g.*, sodium peroxide, a quantity of citric acid sufficient to neutralize the alkalinity due to the peroxide is added, and the whole is then heated to 30° to 52° C. for 30 minutes or more."

***

THE REFRIGERATION OF A CITY'S MILK SUPPLY.—By C. Bates (Abs. in Science N. Ser., 42 (1915), No. 1079, p. 319).

In bacteriological examinations of a city's milk supply the Bureau of Chemistry of this Department has found that the chief cause of high bacteriological counts was due to non-refrigeration of milk in transit, the average temperature of the milk upon receipt in the city being about 65° F. This milk was *en route* from 6 to 12 hours. Refrigeration has now been provided by the railroads, and the milk at the present time is being received in the city at about 48.

***

OIL ENGINES FOR PUMP IRRIGATION AND THE COST OF PUMPING.—By G. E. P. Smith (Arizona Sta. Bul. 74 (1914), pp. 379-450, Pls. 4, Fig. 16).

This bulletin describes fuel oils and their tests and oil engines of the Diesel, modified gasoline engine, and hot-ball groups, reports tests of the last two types as to fuel economy, capacity, speed regulation, and power development, discusses oil engine characteristics based on the tests reported, and gives data on the cost of pumping for irrigation.

It is pointed out that gasoline is too expensive a fuel for pumping engines in Arizona. Cheap distillates of from 39 to 44 Baume with low flash point are deemed the most advisable to use at the present time, these being preferably purchased in carload lots.

It is thought that Diesel engines are not adapted to farm conditions. "Four-cycle gasoline engines with

electric ignition and suction fuel feed can be modified to burn heavier distillates successfully by feeding water with the charge. Preheating of the charge, also, is necessary in cold weather, and the heavier distillates require higher compression and earlier ignition than gasoline in order to give the best results. The water feed is the most important factor .... Gasoline engines already in service can be altered by replacing the fuel mixer and the exhaust block specially designed ones, or by adding a home-made device for feeding water into the air inlet pipe ...... The effects of the water in the charge are softened explosions, more complete combustion of the fuel, a cleaner cylinder, cleaner valves, uniform temperature with reduced loss of power in the jacket wat and no pre-ignition. Despite the loss of power in the heat of vaporization of the feed water, the fuel economy of the engine is not lowered.

"Two-cycle engines with hot-ball ignition and fuel injection at the end of the compression stroke can be operated on low gravity distillate, even down to 30 Baume for small engines, and to 24 Baume for large engines, provided the compression pressure is increased to 180lbs. per square inch. As in the case of 4-cycle engines, water feed is essential except perhaps when the engine is carrying less than one-third of its full load. . . . Forced-feed lubrication is necessary for hot-ball engines and is desirable for large 4-cycle engines. Pump circulation gives much better results than the thermo-siphon system for hot-ball engines.

"Fuel economy of 9 or 10 brake horsepower hours per gallon of fuel oil is possible with farm engines of either type, assuming the engine to be in good condition. In the average ranch pumping plant on the fuel economy is about 6 or 7 horsepower hours per gallon. The determining factor of fuel economy is the adjustment of the fuel valves. . . . Nearly all oil engines are operated with the fuel valves opened wider than is necessary. . . . Mechanical losses of power in an engine are most important when the engine is only partly loaded. An engine should be run at from three-quarters to full load. A purchaser should compute his power requirements carefully and then add about 15 per cent. to determine the size to buy. At altitudes of

from 3,000 to 5,000 ft. from 25 to 30 per cent. should be added to the computed capacity. The piston displacement per minute per horsepower is the best indication of the capacity of an engine. . . . The quantity of humidifying water should be controlled by the governor. . . .

"Four-cycle oil engines with electric ignition are proving to be quite as reliable as gasoline engines. The combustion of the fuel oil is perfect and there is no exhaust smoke. The explosions can be timed perfectly and they occur with great regularity. Compared with gasoline, the only disadvantage in burning tops is with respect to starting in cold winter, when it is necessary to run for from one to five minutes on gasoline and then change over to top.

"The experience with hot-ball engines in Arizona to date has been unsatisfactory. The combustion is imperfect, usually bad. Hot-ball ignition has serious disadvantages. The evil-effects of leaky compression are very great. Pump lubrications, water-circulating pumps, and friction-clutch pulleys are required even on small engines. On careful analysis the hot-ball engines do not have any advantage in simplicity. Their useful life will be less than that of 4-cycle engines. . . . .

"The use of tops in place of engine distillate decreases the cost of pumping from 20 to 40 per cent. The cost of pumping on a 40 ft. lift with 4 ft. depth of application varies from 8*s*. to 2*s*. per acre, according to whether the plant is used much or little. Under the most favourable conditions the cost of pumped water is no greater than the cost of river water. The cost of pumping on a 100 ft. lift with 4 ft. depth of application varies from 20*s*. to 40*s*. per acre. Ranches dependent upon so high a lift should be devoted to high-priced crops, such as orchard fruits and vegetables, or to crops whose water requirements are low, such as millet, sorghums, corn, and sugar beets. Not over one-fourth of the acreage should be used for alfalfa. Electric power at rates prescribed by the Arizona Corporation Commission is much more costly than the use of oil engines. The largest item of cost is the fixed charges. In order to reduce these charges the plant should be used in all possible ways. Never shut down at noon or at night

through the irrigation season from March to July. One pumping plant should serve two or more ranches."

*
* *

ELECTRICITY FOR THE FARM —By F. L Anderson (New York : The Macmilion Co., 1915, pp. XXIII + 265, Pls. 8, Fig. 42)

This book is intended primarily to give the farmer a practical working knowledge of electricity for use as light, heat, and power on the farm. It is divided into three parts with reference to power sources, namely, water power, electricity, and gasoline engines, wind-mills, etc.

The following chapters are included, a working plant, a little prospecting, how to measure water-power, the water wheel and how to install it, the dynamo, what it does, and how : what size plant to install, transmission lines, wiring the house, the electric plant of work, gasoline-engine plants, the storage battery, and battery-charging devices

All correspondence regarding the Journal, advertisements, etc., should be sent to the Hon. Secretary, Dairy Education Association, No. 12, Victoria Road, Poona.

This Journal is issued Quarterly, in October, January, April, July.

RATES OF SUBSCRIPTION.

Annual subscription :—

Non-members, including postage	...	Rs. 4-0-0
Members of D. E. A. ...	...	Free
Single Copy, including postage	...	Re. 1-0-0

ADVERTISEMENTS.

			Annual.	One issue.
Full	page	.	Rs. 20-0-0	Rs. 6-0-0
Half	,,	...	,, 13-8-0	,, 4-0-0
Quarter	,,	...	,, 7-0-0	,, 2-0-0
6 Lines	...	.	,, 3-0-0	Re. 1-0-0

DAIRY EDUCATION ASSOCIATION.

.................................191

THE HON. SECRETARY,

DAIRY EDUCATION ASSOCIATION

(INDIAN BRANCH),

POONA.

Dear Sir,

I wish to become a member of the above Association, and if elected agree to promote the welfare of the Association to the best of my ability and to remain liable for my subscription until I shall notify the Hon. Secretary of my resignation. On receipt of your letter advising me of my enrolment as a member, I will forward the yearly subscription of Rs. 3/12/- to the Hon. Secretary (Mr. G. H. Frost, Government Military Dairy Farms, Poona).*

Dairy School or Schools attended and length of time of instruction.

....

....

Dairying Certificate, Diplomas, etc.

....

....

(Signed)..

Mr., Mrs., or Miss, etc.

Permanent Address...

....

* *The Year commences on 1st October.*

VOL. III, PART 4. QUARTERLY. JUNE, 1916.

THE JOURNAL OF DAIRYING

AND

DAIRY FARMING IN INDIA

DAIRY EDUCATION ASSOCIATION

D. E. A

Printed by Thacker, Spink & Company, 6, Mangoe Lane, Calcutta, and
Published for the Committee, Dairy Education Association in India

CONTENTS.

THE

JOURNAL OF DAIRYING

and

Dairy Farming in India.

VOL. III.—PART 4.] QUARTERLY [JUNE, 1916.

EDITORIAL.

WE thank those readers of our journal for their letters of appreciation of the Committee's efforts to publish interesting and helpful articles and notes for the benefit of our members.

*
* *

THE Committee would be grateful if members would assist by taking a more active part in the work of the journal.

They would be glad to receive for publication notes and figures of experiments carried out under their observation.

This would undoubtedly help other members and would be much appreciated.

It is interesting to learn that after the war attention will be paid to the problem of milk supplies to Indian cities. The crying need of legislation with regard to the dairy industry is too well known to our readers to render any further explanations necessary.

The recently published figures of the mortality amongst children in cities render it most imperative to the future interests of India, and the matter should have immediate attention.

The problem is not an easy one to solve, and will require delicate handling.

It is no easy matter to eradicate methods that have been in existence for hundreds of years, and to break down customs handed down for generations.

*
* *

The problem of the transport of milk from the mufassal to cities has been receiving attention, and will do much to assist in the solving of the supply question.

Many members of the society are daily carrying out the system of the transport of milk long distances by rail, and we hope in the near future to publish some reliable data in this connection.

*
* *

Copies of

Bulletin No. 2 ... Some Improvements in the Packing and Transport of Fruit in India
,, ,, 3 ... Soil Ventilation
,, ,, 4 ... The Saving of Irrigation Water in Wheat Growing
,, ,, 5 ... Clover and Clover Hay

edited by Albert Howard, C.I.E., M.A., Imperial Economic Botanist, Pusa, and Gabrielle Howard, Second Economic Botanist, Pusa, have been received.

They afford most valuable information to the student and agriculturist, and should be in the hands of all. "The Saving of Irrigation Water in Wheat

"Growing" is one of immense importance, and the experiments in this connection at the Fruit Experimental Station, Quetta, have yielded most favourable results.

It is expected that details of these experiments will be published in the Journal at a future date.

The cost of these important bulletins is four annas each excluding postage. They may be obtained from the Secretary of the Journal.

***

THE results of the trials of the motor ploughs and tractors at home will be read with interest The use of one adapted to Indian conditions would be a most useful machine for Indian agricultural work.

***

THE annual examination for National Dairy Diploma in Dairying will take place in Poona in the month of December.

The dates on which the examination will be held will be notified later. Mr. Jaimal Singh of the Jhalavar State has been elected a member of the association.

THE POISONOUS CHARACTER OF YOUNG *JOWAR* PLANTS AS FODDER.

BY

HAROLD H. MANN.

THE finest and best fodder crop in India, and perhaps in the world, is *jowar* or *cholum* (*Anthropogon sorghum* or *Sorghum vulgare*), but its use is affected by one great difficulty. The plant cannot be cut and used as fodder until the flowering stage, owing to its being very poisonous to stock in its earlier stages Whenever grown, therefore, it must be kept till it flowers before it is used, as, even when dried, there seems a good deal of doubt as to whether it does not still contain some of the poisonous principles.

These facts have been long known in India, where the following points are usually stated by experienced cultivators :—

(1) *Jowar* fodder is usually dangerous till the flowering stage.

(2) The dried fodder is much less dangerous than the green fodder, even if it is dangerous at all.

(3) The *rabi* or autumn varieties are much more dangerous than the varieties grown in the rains.

(4) The most dangerous of all is a crop which has grown vigorously and luxuriantly and then been checked and stunted by drought or disease.

The poisonous effect of the fodder is very striking, and has been attributed to many causes. The following is a description of its effect from experience at Allahabad.

"There is some danger of poisoning the animals fed on any species of sorghum (i.e., *jowar*), which has been cut when only a few feet high after a long break in the monsoon. . . . Animals which have been fed on the poisonous plants die very soon with symptoms resembling tympanitis : in some cases animals have died within twenty minutes on eating the fodder. An instance occurred on the Allahabad farm when sheep, which were hired for the purpose of stock manuring, were at the request of the owner turned out to graze an aftermath crop of *sorghum vulgare*. Eight of the sheep died within a few minutes, and many more were saved merely by the rapid administration of purgatives. During lengthy breaks in the monsoon, when the sorghum thus becomes poisonous . . there is danger of grass cutters bringing in some of the small plants of the sorghum when chilling grass from among the crops. At Allahabad in the summer of 1896, a number of horses belonging to private individuals died from the same. The season was an exceptionally dry one : in fact, the monsoon failed, and the crops being stunted and partially withered, the grass cutters were allowed by the ryots to take grass from the jowar field." *

Similar results have been described in other countries. Peters in 1901 in Nebraska, U. S. A., describes how fifteen cattle broke into a field and remained twenty minutes—three became sick and died in a few hours. The same worker then put two young cattle in the field, one ate the *jowar* and was so badly affected that it fell ten minutes after entering the field, and lay with twitching muscles in various parts of the body, paralysis of the tongue, and increased salivation. It had eaten one and a half pounds of sorghum leaves.†

The cause of this was for long unknown. It was attributed to various causes, including the presence of nitrate of potash in the plant.‡ It was, however, shown by Dunsten and Henry § in 1902 that the young plant when crushed in water gave hydrocyanic (prussic) acid, and evidently contained a substance (cyanogenetic

* Meagher and Williams—The Farm Manual (Calcutta, 1903), page 59.
† Nebraska Station Report, 1901.
‡ Meagher and Williams—The Farm Manual (Calcutta, 1903), page 59.
§ Proceedings of the Royal Society, Vol. 70 (1902).

glucoside) which was capable of giving the poison when in the digestive system of an animal. These observations have been confirmed in almost all the *jowar* (sorghum) growing parts of the world since that time. Some of the determinations of the hydrocyanic acid which the fodder is capable of giving are as follows :—

(1) Leather* (India) found that one pound of green fodder grown under irrigation, and in the flowering stage, gave 1·28 grains of hydrocyanic acid. The quantity in the various parts was very variable. In a sample giving 0·17 grains hydrocyanic acid per pound in the dry sample, the leaves gave 2·5 grains, the stalks 1·1 grains, and the flowers only 0·25 grains. He states that drying in the sun had no effect on the quantity of hydrocyanic acid.

(2) Brunnich† (Queensland) found that the poison decreased as the crop matured, and it was safe when the seed developed. Drying does not remove it, and high manuring with nitrogenous manures causes it to increase. He considered that it was specially dangerous to feed the jowar fodder to fasting animals. The highest quantity he found was 0·81 grains per pound of green fodder. He thought that if there was less than 0·5 grains per pound of green fodder it was safe. Maxwell,‡ also in Queensland, gave similar results, but considered that the quantity of poison varied much with the soil.

(3) Trumbull§ (Nebraska, U. S. A.) found the following quantities of hydrocyanic acid produced by plants in different degrees of vigour. Dark green healthy plants 50 cm. long—·01215 per cent.; yellowish green plants 35 cm. long—·00499 per cent.; yellow plants only 22 cm. long—·00405 per cent. His figures confirm the conclusion that vigorous plants contain more than poorly grown plants.

(4) Balfour,‖ in the Soudan, where the plant has caused much poisoning, gives a case which yielded,

* Agricultural Journal of India, Vol. I (1900), page 220.
† Journal of the Chemical Society, Vol. 83 (1903), page 788.
‡ Queensland Agricultural Journal, Vol. 13 (1904), page 473.
§ Nebraska Station Report, 1909.
‖ Report Wellcome Research Laboratory, Khartoum, 1903-04.

when sixteen inches high, 0·035 per cent. of hydrocyanic acid. The opinion there is the same as in India, as given by Neville and by Borton (quoted by Balfour) that *jowar* is the most dangerous when (1) it has been stunted for want of water and has then grown vigorously when water is obtainable (Neville), (2) it is stunted by rainfall suddenly ceasing after a good start in growth has been made. In the Soudan. the people consider that ruminants (cows, etc.) are much more easily affected than donkeys or horses.

(5) Willaman and West* (Minnesota, U. S. A.) are the most recent workers on the subject. They conclude as follows :—

(*a*) When sorghum (*i.e. jowar*) is grown on poor, infertile soil, added nitrogen (*i.e.*, nitrogenous manure) may slightly increase the amount of hydrocyanic acid in the plant. With a fertile soil and abundant nitrogen this effect may not be produced.

(*b*) During the first three or four weeks of the plant's life the prussic acid is concentrated in the stalks. Then it rapidly decreases and disappears there, but apparently persists in the leaves in decreasing percentages until maturity.

(*c*) Climate and variety may be more important factors than soil nitrogen in determining the amount of acid (*i.e.*, prussic acid) in the plant.

They found that weak and stunted plants contained little poison, but this does not of course touch the plant held by the cultivators here, and in the Soudan ; also (*vide sup.*) that vigorous plants, afterwards stunted, are particularly dangerous.

The general result of all this discussion is then

(1) that the cause of the poisoning action is hydrocyanic acid produced when the fodder is eaten ;

(2) that *jowar* fodder should not be used till after flowering—either in the first or the second crop ;

* Journal of Agricultural Research, 1915.

(3) that regular growth should be aimed at, sudden growth after it has been stunted, or stunting after good growth tending to increase the poisonous properties ;

(4) that it remains very doubtful whether drying of poisonous fodder gets rid of the poison ;

(5) that the ratoon crop is much relished by cattle, but when young is more poisonous than the original crop.*

* Benson and Subha Rao. Bulletin No. 55. Department of Agriculture, Madras, page 119.

AN ENGLISH STUDENT'S NOTES ON FARMING IN INDIA.

BY

N. S. G.

It may be interesting to note the things that impress an English farm student in connection with the dairy stock of this country.

When we compare the methods of stock-breeding and the care of animals, as carried on in India with the way in which cattle are handled at home, we are at once struck with the careless manner in which all matters that really count in breeding and milk production are left to chance by the native stock-owner.

For instance, in the case of breeding, cows are allowed a more or less free range, and are liable to come into contact with any bull, immature, old, diseased, of bad milking strain, or of an inferior breed. All of these most important points are disregarded, and breeding goes on in a very haphazard and primitive way. It is no wonder that the stock is undersized and of poor milking quality.

In considering these points, we see that all rules that have been formulated to promote the production of high producing animals have in the past been absolutely ignored, and as a result the original stock has not been lifted out of its scrub condition.

It has only been by means of selective breeding that the high producing qualities of European and American stock have been developed, so that to bring India to her own as one of the leading dairying countries many of the customs at present prevailing must be swept away and methods substituted that have proved so successful on the continents above mentioned.

To understand how far we are behind in the breeding of high profit making cows, it is only necessary to compare the milk yields of European cows with the records of our Indian cattle. The average yield of the former is from five to ten hundred gallons per lactation and the latter from one to three hundred gallons per lactation period. When we consider the fact that only a few centuries ago cattle in Europe were in the scrub condition, and that the present day stock have been raised to their high standard by progressive efforts of generations of stock-breeders, it should give us encouragement to tackle the problem of stock improvement in this country.

In India breeds have not been kept pure, and it is now difficult to obtain pure blood stock. No effort has been made to breed for milk production owing no doubt to the idea that it is a secondary matter to the raising of draught animals.

Having noted the main points in which the Indian stock-breeder fails, let us see by what means he can improve his cattle.

The main points lie in keeping the various breeds in the country pure, and in developing these breeds along lines consistent to the object in view. Breeds that have points indicating that it is a better animal for draught purposes than for milk should be selected and bred for that purpose only. The same principle applies to those breeds that show good milking qualities.

Great progress in this connection has been achieved on some of the farms carried on by Government. Selective breeding by itself would take a long time to bring about results, but by importing pure bred bulls of proved milking strain and crossing the ordinary country cow an half-bred progeny is produced. The half-bred cow has proved to be vastly superior to its country dam in milking qualities, giving at least twice and often thrice as much as its mother.

This important improvement has been obtained in the short time that the department has realized that success lies only in progressive breeding, and points out the way in which the stock of this country may be easily improved.

At present the milk-producing problem in India is very acute. High infant mortality and the increasing city populations render this matter of utmost importance. Steps should be taken to increase the milk-producing power of the cows and to prevent the adulteration of milk by enforcing a pure milk standard.

This is rendered necessary by the wholesale adulteration carried on by milk vendors, as shown by the report of the Health Officer to the Delhi Municipality, in which he states that not one pure sample of milk was found in nearly fifty samples examined. This brings to light a very bad state of affairs, and taking Delhi to represent most of the cities and towns in India it shows the need of a measure to control the milk supply.

Better housing of cattle is necessary from the breeding as well as the sanitary point of view. To bring animals to their highest standard of development good sheds, well ventilated and drained, should be provided, giving the animal the chance to prove that under good conditions a better class will be produced. In this connection it is interesting to note some of the methods under which cattle are kept by the native. For instance, even in a large city such as Karachi, the cattle often live in the same room as the owner or even live in the streets, having no stable set apart for its accommodation. It is a common sight to see milch animals roaming about the streets at their own free will, picking up their food from the goods displayed in the fronts of shops, and what is much worse from the rubbish thrown into the streets—a most undesirable form of food—for the production of sanitary milk.

Foodstuffs are very cheap, both concentrated and fodder, and should make for the cheapness of a good quality milk.

It appears almost criminal to note the small amount of assistance given by stock-owners to prevent the spread of disease.

In India disease is almost always prevalent in some form or the other, and infection is carried about by the movements of animals without the least regard to the principles of segregation.

It is only after an outbreak of disease has assumed an epidemic form that the authorities are communicated with to enable the Veterinary Department to take action.

Agricultural education should do away with a great deal of the evils mentioned, and the good work of the Agriculture Department should be speeded up so as to reach the actual worker and producer, who after all is the dominating class and the one to be considered in this great work of agricultural improvement.

STOCK MANURING.

BY

H. ST. JOHN.

Stock manuring must continue to be the main fertiliser at the farmers' disposal.

It is doubtful if farmers appreciate the value of this manure, and they certainly do not utilize it to its fullest extent.

In India the native agriculturist in the past has to a great extent ignored this important factor in the cultivation of crops, although it must be conceded that in many districts this matter is being more valued.

A large percentage of animal manure in this country is used as fuel, and the balance that is not used in this manner is so badly conserved that its manurial value is practically lost, before it is applied to the soil.

It must be remembered that farm-yard manure contains all the properties necessary for the growth of the crops.

It returns to the soil the manurial ingredients taken up by the crops.

It is produced by every stock holder, and is a suitable manure for nearly every crop.

The use of artificial manures has of late years greatly increased, and although there is a great deal to be said for these manures, it is held that they should assist more as a supplement to farm-yard manure than to be the sole method of manuring.

It is considered that many farmers do not understand the conditions that influence the value of farm manure, hence the proper utilization of this most valuable product has been neglected.

Dung contains all the elements necessary for plant food, and that which is likely to be deficient in the soil.

It contains nitrogen, phosphates, and potash, and although it must be conceded that artificial manures contain a higher percentage of these elements, it must be taken into account that this is largely compensated by the heavier dressings usually used when employing stock manure. Nitrogen and phosphates are found in a more complex compound in dung than in artificial manures; consequently the effect of stock manure dressings covers a longer period. This effect cannot be obtained with the use of artificial manures and has a most important effect on the fertility of the soil.

By using long manure it opens up and ventilates the soil, renders it more friable and pervious to air and water.

It has other important advantages, in facilitating the drainage, and certainly renders the working of the land much easier.

The recent published bulletins which are referred to in the editorial page, written by Albert Howard, C.I.E., M.A., and Gabrielle Howard, M.A., are a most important treatise on this subject, and will be read with interest by those interested in the successful growing of crops.

The use of farm-yard manure on light lands increases the retentive power of the soil, both for moisture and food and plant life.

With the use of farm-yard manure the stock of vegetable matter is increased, which is just the opposite when artificial manures are used.

In India and in other countries the liquid portion of the manure is often lost sight of, and as this contains a large proportion of nitrogen and potash in a quick acting and readily available form, this loss is a very important one.

Manure from which the liquid portion has been allowed to escape is much reduced in value.

It is not generally known that the kind of food on which the animals are fed, greatly affects the value of the manure.

Animals fed on cotton and linseed cakes, which are rich in fertilizing qualities, produce good manure.

The average proportion of the totals of each of the manurial ingredients consumed in the food, which pass into the manure is nitrogen 75 per cent. and phosphates 90 per cent.

Then again, the age and kind of animal affect to a great extent the value of manure produced; young animals and cows in milk extract a larger proportion of valuable ingredients from their food, which is assimilated in their system, as compared with working animals and fattening stock. Therefore the manure voided by the latter class of animals is much more valuable than that by the former.

A cow in full milk will extract from its food 4 to 5 times as much nitrogen and 3 to 4 times the amount of phosphates and 10 times of potash as a working animal fed on exactly the same ration.

The amount of litter mixed with the manure and the degree of decomposition are also important factors in the manurial value of farm-yard manure.

Bulky litter slightly rotted has the best effect on stiff soils, whilst the reverse holds good on light soils.

It is an important point to remember there must always be an appreciable loss in nitrogen in the storing of the manure, but the loss will be greatly minimised by storing under good conditions. The aim should be to retain in the rotted manure as large a percentage as possible of the manurial ingredients that are found in the fresh manure.

Rotted manure under good storage conditions contains ready material for plant food and it cannot be sufficiently impressed on the farmer, that much valuable material is lost by bad storage.

Care should be taken to prevent loss by drainage, and over-heating, which drives off a good deal of the nitrogen present in the manure.

The storing process should be carefully supervised, and care taken the manure is evenly rotted; that from animals yielding dry manure, being carefully mixed with that containing more moisture. The manure should be kept moderately moist, and well compressed and whether stored in pits or heaps, the floor should be made of concrete or brick on edge. A layer of well

rammed clay plastered over is quite good enough for Indian conditions

A layer of old straw, roughage,. or some other absorbent material is necessary to be put on the floor of the pit or heap, and at the sides if stored in pits.

The site selected for the storage of the manure should be on high level ground, and in a position that water does not percolate into the pit, and should be in close proximity to the byres or stables.

There is no need to erect a roof over the pit provided no other water than rain water can get into the pit

Many farmers prefer the use of heaps on the ground on which the manure is to be spread, but in this case utmost care must be exercised in its preservation, and the manure well compressed and the sides of the heap well covered over with earth to prevent the escape of nitrogen.

Various ammonia-fixers have been tried to prevent the escape of nitrogen in the form of ammonia gas but the result has not been good. Ordinary loam soil is the cheapest and most efficacious of ammonia and liquid manure absorbents.

Liquid manure may be utilized by mixing it with the solid dung; this improves the quality of the manure. When the supply is large the best means of its disposal is to collect it into a tank and pump it on the soil as a top dressing. Where irrigation water is available it is best to dilute it as fresh liquid manure has a burning effect on plants and if it cannot be diluted it should be left in the tank several weeks before it is applied to the soil.

Dung is most advantageously employed when used fresh, but this is not always practicable. On most soils the best results are obtained by storing the manure during the winter months, and applying it in the spring immediately before the crop is sown.

To summarize the important points in the treatment of farm-yard manure :—

1. Select a suitable site where there is small chance of loss through drainage.

2. Make the bottom of the heap or pit impervious to liquids.

3. Mix the manure well from the stables or byres.
4. Keep the manure compact, solid, and moist.
5. Allow no waste of liquid, it is the most valuable part of the manure.
6. Incorporate as much of the liquid with the solid manure as is practicable.
7. Use moderate dressings of manure and supplement with artificial manures.
8. Do not leave heaps of manure on the land unspread.
9. When applying, spread evenly.
10. When applying, do it as quickly as possible.

DAIRY FARM MANAGEMENT IN INDIA.

BY

MEOLCIAN.

Dairy-Technology.

Milk and cream is a much greater anxiety in a country like India where the temperature averages approximately 100°F. the whole year round than in temperate climates If this temperature ruled in Western countries the average dairy-men would be in great difficulty and many valuable alterations would be made in their methods and machinery. This will indicate what difficulties dairy-men in India encounter since they have been trying to work on Western lines with Western machinery. The day is dawning when we shall modify our methods, machinery, and system of instruction to suit the country.

A really up-to-date dairy must have a refrigerator with cold storage, but outside the Government institutions, there are not probably more than two dairies so fitted; these are both European farms. In India milk is generally taken straight from cow by consumers, but the knavery of the average *Gawalla* makes it almost impossible to obtain the milk pure even when the milking is supervised by the lady of the house. Therefore good up-to-date dairies with bottle delivery are a great boon.

The customer in India is usually guided by home methods in keeping milk, which are most unsuitable. They are told perhaps that milk should be boiled, but are seldom told that it should be cooled again immediately afterwards and kept cool, which is the most important point. In fact, if customers would keep their milk cool

by standing it in cold water and placing a muslin cloth over it with the ends in water they could keep the milk sweeter and longer than with their present methods. If a cold store and cooling plant is not installed in a dairy the milk should be cooled over a water-cooler and sent out without delay. When there is sufficient trade pasteurisation may be carried out but where milk is produced on sanitary lines and issued at once this process is waste of money and time.

Cream is invariably skimmed by separators and in India no other way is satisfactory, as milk cannot be kept long enough for the various setting pan systems. The native system of heating the milk and agitating it to cause the fat globules to coalesce, so that a considerable quantity can be removed, is not recommended for many reasons.

It is regrettable that the general public do not realize the value of skimmed or separated milk. It may be used profitably as a food more extensively than it is both in the kitchen as an ingredient in cooked foods and for direct use as a drink. When the butter fat is removed, the percentage of the other milk components is slightly increased. The protein, sugar, minerals, and some fat is still left, and these are the most important from a food point of view except for very young children. Ten ounces of bread and one pint of skimmed milk is equal to $\frac{1}{3}$ of the diet required by a man in one day.

Cream.—Cream is the portion of milk containing the bulk of the fat. In India it usually contains 50 per cent. or more of butter fat. Cream in India lacks the peculiar delicious flavour of cream obtained from cows' milk in Europe and is generally much richer as the European market retails at 18 to 25 per cent. of fat.

The advantage of cream as a food is its high digestive quality. Sweet cream is perhaps relished by more people than is any other single food. When India can produce cows that give yields of from 5 to 10 thousand pounds per lactation, we may sell cream from cows' milk which is much nearer the European article in flavour.

Abnormal Milk.—Milk may acquire abnormal flavours in many ways:—

(1) The cow may be slightly sick.

(2) Highly-flavoured foodstuffs may be fed.

(3) Silage or byres may impart their strong smells to milk if the latter is kept in the vicinity of the former. Milk rapidly absorbs any smell and for this reason strong smelling disinfectants cannot be used in dairies and cattle sheds.

(4) Ordinary souring may be accelerated by dirty vessels, milker's hands, dusty atmosphere, dirty udders, and the dirt from the animal's body, insanitary surroundings, or a temperature ranging between 75° F. and 100° F.

(5) High temperatures while pasteurising will change the flavour considerably and alter some of the constituents of the milk.

(6) Colostrum is an abnormal milk and care should be taken to prevent its admixture with other milk until it is proved to be normal.

(7) India is not often troubled by coloured, bitter, or ropy milk but where gross carelessness is met with these may occur.

(8) Milk kept too long in cold stores loses its normal flavour by the growth of undesirable bacteria unless it is very low in temperature. This may be improved by re-pasteurising and cooling slowly so that it may become well aerated.

The study of Dr. Joshi's book on the milk problem in Indian cities shows many causes with remedies for abnormal conditions in India.

DEMONSTRATIONS OF MOTOR PLOUGHS AND TRACTORS.

As a result of suggestions made by the Board of Agriculture and Fisheries, demonstrations of labour-saving machinery have recently been carried out by the County Councils of Lincoln (Lindsey), Essex, and Northants, the Suffolk Agricultural Association in conjunction with the East Suffolk County Council, and the University of Cambridge. The demonstrations had regard chiefly to motor-ploughs and tractors.

From the point of view of the attendance and interest aroused on the part of farmers, the demonstrations were all extremely successful.

The conditions under which the trials of motor ploughs and tractors took place were, perhaps, too favourable for definite conclusions to be formed as to the general usefulness of the various machines. The weather was fine in all cases, and the land generally dry; the soils were, as a rule, light, but in the Cambridge demonstration the soil was a heavy loam. It must, of course, be remembered, on the other hand, that wet weather need not seriously interfere with the employment of motor ploughs and tractors, since the work may be done sufficiently quickly to be accomplished in spells of fine weather. It is probable that the motor ploughs and the lighter tractors will usually be workable under the same conditions as horse-drawn ploughs. The soil in Cambridge demonstrations was so hard that it was doubtful whether horse ploughs would have worked successfully. Cross ploughing and the ploughing in of dung were not tested in these demonstrations.

The number of machines tested was affected by the difficulty experienced by the manufacturers in supplying

machines and men and by difficulties of transit. In some cases the railway companies were able to afford special facilities for delivery. The prices of the motor ploughs (combined plough and motor in one) tested are lower than those of the tractors (*i.e.*, without ploughs); the motor plough would be most suitable where the ploughing can be spread over several months. On the other hand, the tractor is favoured where large areas have to be ploughed quickly, and where there is much haulage and threshing to be done.

Demonstrations of the *Fowler-Wyles Motor Plough* were given at Frithville (Lincolnshire) and Bramford (East Suffolk), at both of which places it did good work. The motor drives two spiked wheels, and it is very simply controlled with one lever by a man sitting in the rear; the plough may be used for either single or double furrow work. Its small size (3 ft. high by 2 ft. 4 ins. wide) allows of its employment in hop gardens and orchards where horses are less suitable. It seems to be capable of ploughing about 3 acres a day. Various kinds of farm work other than ploughing, *e.g.*, cultivating, are possible. When not in use in the fields the engine may be used for grinding, chaff-cutting, etc.

The Wyles Motor Plough is similar in type to the foregoing, and is adapted for the same kind of field work. It is, however, fitted with a more powerful engine. It did very good work at Chelmsford. A suitable pulley is attached for belt driving.

Martin's Motor Plough was exhibited at Frithville, Appleby (Lincolnshire), Cambridge, and Bramford and it did good work. The feature of this machine is that it obtains its motion from an endless chain or "creeper" 6 ins. wide, giving a 3 ft. continuous tread. There is a creeper on each side, and the one in the furrow has a tendency to break up the soil rather than solidify it. The creeper device worked well on dry, light land, and when the plough was replaced by a cultivator the engine drew this readily through the freshly ploughed ground without injury to the soil. At Appleby, although some time was occupied in examination and enquiries, it ploughed 1½ acres in 4 hours (double furrow).

Each of the foregoing machines is easily worked by one man; the consumption of petrol varies from $1\frac{1}{2}$ to $2\frac{1}{2}$ gals. per acre. They can turn readily on a 4 to 5 yd. headland and appear to be better adapted than tractors for small fields, hilly land, and land on the ridge system.

Crawleys Motor Plough, also self-contained and manipulated by one man, did excellently at Chelmsford, and attracted much attention at Cambridge, where it worked powerfully, and drew a 3-furrow plough at considerable speed on all classes of soil. It has evidently plenty of power, and is capable of ploughing the heaviest classes of soils satisfactorily. It seems easy to control and requires a narrow headland.

The Weeks—Dungey "Simplex" Tractor is a compact machine measuring 7 ft. 4 ins. long by 4 ft. wide, and 4 ft. 9 ins. high; it was generally liked at the Frithville demonstration for its compactness, and was, in fact, one of the best of the small type machines. Three speeds forward and one reverse are provided, and, although some doubt was expressed at Frithville as to its ability to work in wet weather without slipping, the makers claim that the speed attachments overcome this difficulty. At Frithville, Appleby, Cambridge, Northants, and East Suffolk (the demonstrations in which it was tried) it did good work and required very small headlands. Under the conditions in which it was tried, the engine was easily capable of pulling the double furrow plough although not so fast at Appleby as the "Bull." The machine appears useful for slow haulage work; it is said to be able to pull 5 tons on the level. Two men are required for ploughing.

The Big Bull Tractor is a three-wheeled machine with a powerful engine, capable of pulling a 3-furrow plough; its length is 13 ft. 11 ins. and height 6 ft. 3 ins. The driving and single steering wheel run in the furrow, and did not pack the land.

Some Lincolnshire farmers thought that this arrangement of the driving and steering wheels, although generally commendable, might be disadvantageous under certain conditions by consolidating the furrow bottom too much; on the other hand, it was noticed at Cambridge, on the heaviest part of the land, that the

single-tractor wheel in the furrow seemed inclined to churn up the subsoil.

The fact of the driving wheel running in line with the steering wheel makes the tractor automatic self-steering; it only needs driving round the ends. The tractor required two men to handle it in the demonstrations, though the makers claim that one man can do the work when their own plough is fitted.

At Cambridge the tractor drew a 2-furrow plough, and ploughed a greater area than any other machine, working steadily through the day. At Appleby, 3 acres of land was well ploughed 5 ins. deep in 4½ hours; in a test in Lincolnshire earlier in the year, 1 acre was ploughed in 1 hour 50 mins., a little over 2 gals. of petrol being consumed. The tractor left a narrow headland at Appleby, but was not particularly handy at the headland at Cambridge.

A point which was not tested was as to whether a three-wheeled tractor is desirable for a really stiff soil. Further, in Lincoln the question was raised as to whether a 3-wheeled tractor is equal to a 4-wheeled one for haulage purposes, but apparently the chain adjustment at the back permits of an even and direct pull and the single steering wheel is no disadvantage. The question of backing the machine might be a difficulty in reaping.

A feature of the machine is the ease with which the working parts may be inspected.

The Mogul Tractor is a very powerful machine pulling a 4-furrow plough. It is started on petrol, and runs on paraffin. It has two speeds forward and one reverse. It is easily handled, having a steering mechanism of the motor-car type; all the working parts are well protected.

It was tested at Frithville, Chelmsford, Moulton (Northants), and Bramford, and did good work. On account of its heavy weight, however, the wheels are apt to unduly pack the land. It was rather slow at Frithville, and, although ploughing 4-furrows against the "Bulls" 3-furrows, it did not get over so much work as the latter. It is too heavy a machine for small occupiers, and probably too expensive for ordinary farmers. The tractor can haul 10 tons on level roads.

The Daimler Tractor is another machine that is very heavy and expensive for ordinary farmers; the makers intend to turn out a smaller machine after the war. However, it did satisfactory work at the Lincoln demonstrations (it was not tried elsewhere), ploughing about 1 acre per hour. It pulls a 4-furrow plough. No delivery can be obtained at present.

The Saundersons and Mills "Universal" (model G) *Tractor* was tested at Frithville, Chelmsford, and Moulton. It was regarded at Frithville and Chelmsford as an exceedingly useful general purpose machine, and it seems to be one of the best of the more expensive types. An advantage is that it works on paraffin, the consumption of which in ploughing was put at 3 gals. at Moulton, and about 4 gals. per acre at Chelmsford. The 1915 type of machine is stated to be a great improvement on older types. At Moulton it drew a 3-furrow plough at the rate of $\frac{3}{4}$ acre per hour. It has 3-speed gears of approximately 2, 3, and 5 miles per hour forward and 3 reverse speeds It will haul a load of 5 to 6 tons at the rate of 5 miles per hour, and drive a 4 ft. 6 ins. threshing machine. Good work was done by the *Ivel Tractor* at Chelmsford. This tractor has been before the public for 11 years, and its merits are well known

The Overtime was tried at Moulton and Bramford, its work being very favourably commented upon. It drew a 3-furrow plough with ease, but required two men. As a light tractor at moderate price, it appears to be one of the most useful on the market.

A SIMPLE METHOD OF PREPARING CASEIN.

An American method of preparing casein is published as it is thought it may prove of interest to the readers of this journal. The utilization of separated milk in this manner will prove of great economic value in the future.

When fresh, whole milk is left at rest, or is set in very rapid rotary motion by means of special appliances (centrifugal machines), the cream, or portion richest in fat, collects on the surface, and if this be skimmed off, skim milk is left. This latter forms the raw material for the preparation of the second chief product of milk, namely, the casein which is present to the extent of 2 to 4·5 per cent, the average being 3·2 per cent.

Skim milk is placed in a vat fitted with stirrers consisting of a vertical shaft carrying several horizontal blades. These stirrers are set going so as to bring the whole of the liquid into rapid rotation, and dilute hydrochloric or acetic acid is run in by degrees. The casein begins to separate immediately in the form of tender white flakes, and the quantity of acid used is strictly limited to the amount necessary for precipitation; while continuing the stirring a sample of the liquid is taken, filtered, and the clear filtrate tested with a little of the acid. If it remains clear, the whole of the casein has been precipitated.

The liquid is then left alone until all the casein has settled down, whereupon the clear liquid may be syphoned off by means of a rubber tube fitted with a glass funnel, the mouth of which is covered with fine gauze and is lowered into the liquid until it reaches the curd, which is kept back by the gauze sieve. The separated liquid contains albuminoid compounds, salts,

and the whole of the milk sugar present in the milk, for the recovery of which it can then be treated.

The casein left in the vat is stirred up with water, left to settle, the water run off, and the operation repeated two or three times. The casein, thus sufficiently purified, is placed in strong filter cloths and laid between wooden plates in a screw press. Pressure is applied gradually and so long as any liquid continues to drop The casein is next taken out of the cloths, and as it still contains a considerable amount of moisture, it is broken down into small lumps which are spread out thinly on cloths stretched on frames. These are placed in a drying-room, kept at a temperature of about 86° F., until the casein is perfectly free from water and will crumble down to powder under the pressure of the finger.

When thoroughly dry, casein can be packed and stored in a dry room for an indefinite period, without undergoing alteration. On the other hand, the presence of even the smallest quantity of moisture enables micro-organisms to develop in the casein and cause putrefaction of the whole mass.

In order to obtain white casein, free from the yellow tinge attaching to that prepared with sulphuric acid, several different acids are used in succession as precipitants, a method which also has the advantage of cheapness. The best plan is to first throw down the casein as curd with sulphuric acid, then dissolve this curd in alkali, and reprecipitate with acetic acid.

"Dry" casein is the kind generally wanted for technical purposes. Various forms of drying apparatus may be used. The following arrangement has proved very satisfactory and cheap besides enabling the heat to be well utilized. Two small brick walls, about a foot high, are built, without foundations, 40 inches apart, each being topped by a coping of wood 6 inches square. The coping is surmounted by a thick strip of damp millboard about 2 inches wide, and this in turn by plates of sheet iron, 40 inches by 80, and $\frac{1}{8}$ inch thick, fastened down by screws, so as to form a long horizontal flue 40 inches wide and 12 inches high. Where the ends of the iron plates join they are supported by wooden traverses to which they are screwed with an intervening

layer of millboard as in the case of the copings. The two ends of this flue are closed by brick walls through one of which exhaust steam is introduced, whilst an opening in the other enables the steam to escape into a small chimney. The flue should have a gentle slope towards this end so that the condensed moisture may drain away. The casein may be dried very quickly on these iron plates by spreading it out on the farther end and turning it over with wooden shovels towards the hotter end. Unless erected indoors, the flue must be covered with a wide roof to protect the plates from rain. By means of this simple appliance, large quantities of casein can be dried in a short time, the only precaution necessary being to protect it from overheating by vigorous shovelling and breaking down the lumps, the flow of steam being also checked if found desirable.

By this means, 100 parts of skim milk will yield about $8\frac{1}{2}$ parts of damp, or $3\frac{1}{2}$ parts of dry, casein. This is put on the market as "technical casein" or "lactarin."

BY THE WAY

THE cleanest milk is that which has been centrifugally cleaned, and separated milk, the latter being subjected to centrifugal force during the separation of the cream from the skim milk. It is only where large quantities of milk are dealt with at a time that a centrifugal milk cleaner is employed. The next best means of cleaning milk is by employing the ordinary cotton-wool type of milk filter as commonly used on the dairy farm.

***

WHEN sour milk is returned to the farm, it may be churned if a churn is available, and the buttermilk used for pig feeding. In this way the butter obtained will lessen the loss on the milk. It is necessary to churn the milk as it cannot be separated if sour. The milk would have to be warmed before being separated, and it would then coagulate.

***

BUTTER that is streaky in colour, or mottled, is often the result of churning the cream at too high a temperature. This also spoils the texture of the butter, and makes it difficult to express sufficient moisture in the course of manufacturing this article. It is important to have butter of a good colour, as when the colour is at fault the flavour is seldom good

***

A FAIR sample of butter should have present in it about ·5 per cent. of curd or caseous matter. When more than this percentage is present the butter will soon go rancid. On the other hand, when less than ·5 per cent. of caseous matter is present, the butter is inferior in quality and flavour.

Milk turns sour in hot weather much more quickly than in the winter. In summer, if the milk is not artificially cooled immediately upon being drawn from the cow, it retains its natural heat for a considerable time. Milk contains all the food elements requisite for germ life, and germs multiply at a very rapid rate in warm milk.

* * *

In the first or "fore-milk" drawn from the cow there are a lot of germs of various kinds which have previously entered the cow's teats. This milk is of poor quality, containing often as little as ·5 per cent. of fat. The last milk, or strippings, is very rich, containing on the average 9 to 10 per cent. of fat. It will therefore be observed that it is highly important to thoroughly strip the cows in order to obtain milk of the best quality from each cow. By discarding the first few squirts of milk from each teat and giving special attention to the stripping, the milk will be of a richer quality and freer from germs.

* *

Warm milk is less viscous than cold, and therefore more easily passes through a fine filtering medium; hence the reason for filtering milk immediately it leaves the cow. All freshly drawn milk contains a certain amount of dirt, etc., and this should be removed by filtration before it has time to dissolve in the warm milk.

* *

Drinking water should be absolutely pure; and all foul pools should be railed off, for cows invariably show a preference for any stagnant pools they can get to.

* * *

Transportation by steam power has made the products of vast inland areas saleable, giving value to lands that were valueless.

The physical conditions of the soil, the moisture stored in it, its temperature, the amount of sunshine, and other climatic influences all play such important parts in the final results, that they not infrequently become a primary, and plant food a secondary, factor in production.

***

While deep preparatory tillage may, and often does, allow the root to descend easily, subsoiling, if not performed at the proper time, or if it is not followed by suitable surface tillage, often arrests capillary action by leaving the subsurface soil, or that which has been loosened by the subsoiler, so porous and non-compacted as to stop energetic capillary action.

***

The greatest benefits from a leguminous crop will be found not upon the crop growing at the same time, but upon the next crop that follows after it is harvested or after it is ploughed in.

**

In the thin and thick seeding of oats there is scope for judgment. The best return in experiments carried out by the Harper-Adams College was obtained by the use of 200 lbs. per acre.

***

In the present war with Germany, Great Britain can expect little help from blunders which may be made by that country's agricultural experts. It is evident that every effort is being made to learn from the mistakes that have been made, and, during the next year of war, to make the agricultural resources of the country yield the greatest food value.—*Journal of Board of Agriculture.*

Generally speaking it is no exaggeration to say that with the exception of very light or stony land, the introduction of the disc harrow reduces the labour, time, and cost of cultivation by 50 per cent. For example, on stubble land where, in order to prepare it for a root crop, it is customary to plough, cultivate once or twice, and sometimes also cross plough, one ploughing followed by a disc harrowing in both directions generally suffices to bring the soil into a fine enough state for drilling. Before drilling, however, it is necessary to level the land with a spring toothed harrow as the disc leaves the land in ridges. Even on heavy clays, the writer has found that one ploughing is all that is required for a drill crop, provided that the stubble is double disc harrowed both before and after ploughing.—*Journal of Board of Agriculture.*

All correspondence regarding the Journal, advertisements etc., should be sent to the Hon. Secretary, Dairy Education Association, No. 12, Victoria Road, Poona.

This Journal is issued Quarterly, in October, January, April, July.

RATES OF SUBSCRIPTION.

Annual subscription :—

Non-members, including postage	...	Rs. 4-0-0
Members of D. E. A. ...	...	Free
Single Copy, including postage	...	Re. 1-0-0

ADVERTISEMENTS.

		Annual.	One issue
Full page	...	Rs. 20-0-0	Rs. 6-0-0
Half ,,	...	,, 13-8-0	,, 4-0-0
Quarter ,,	...	,, 7-0-0	,, 2-0-0
6 Lines ...	...	,, 3-0-0	Re. 1-0-0

DAIRY EDUCATION ASSOCIATION.

________________191 .

THE HON. SECRETARY,

DAIRY EDUCATION ASSOCIATION

(INDIAN BRANCH),

POONA.

Dear Sir,

I wish to become a member of the above Association, and if elected agree to promote the welfare of the Association to the best of my ability and to remain liable for my subscription until I shall notify the Hon. Secretary of my resignation. On receipt of your letter advising me of my enrolment as a member, I will forward the yearly subscription of Rs. 3/12/- to the Hon. Secretary (Mr. G. H. Frost, Government Military Dairy Farms, Poona).*

Dairy School or Schools attended and length of time of instruction.

....

....

Dairying Certificate, Diplomas, etc.

....

....

(Signed)..

Mr., Mrs., or Miss, etc.

Permanent Address..

....

* *The Year commences on 1st October.*

VOL. III, PART IV. QUARTERLY. JULY, 1916.

THE JOURNAL OF DAIRYING

AND

DAIRY FARMING IN INDIA

DAIRY EDUCATION ASSOCIATION

D. E. A.

Printed by Thacker, Spink & Company, 6, Mangoe Lane, Calcutta, and
Published for the Committee, Dairy Education Association in India

CONTENTS

THE

JOURNAL OF DAIRYING

and

Dairy Farming in India.

VOL. III.—PART 4.] QUARTERLY. [JULY, 1916.

EDITORIAL.

THE Committee appeals to members of the Association to endeavour to procure additional members and subscribers to the journal.

We ask that each one would secure at least one new subscriber.

Owing to the departure of some of our members on active service our numbers have been depleted.

***

THE Members of the Association will, we are sure, be gratified to notice that the efforts of the journal, to bring home to municipalities and cities the necessity of a better milk supply, is at last bearing fruit.

The numbers of bulletins and articles published lately show that the awakening to this important question is at hand.

It is now being realized as the people of cities are becoming more enlightened on the subject that the existing conditions are impossible.

*
* *

We are glad to hear from two of our Members, Messrs. Kettley and Draper, who left India at the commencement of the war to join up for service abroad.

The former is to be congratulated on his safe return to Egypt from Gallipolli, and we trust he will survive the dangers of the operations he is now taking part in and return to India safe and sound.

Mr. Draper we regret to hear has been wounded, but we trust he will soon be in health again and tender our heartiest good wishes for his recovery.

*
* *

We would remind our readers of the forthcoming examination for the Degree of National Diploma in Dairying to be held at Poona in the month of December.

The dates of the examination will be communicated to Members at the earliest possible date.

*
* *

The Secretary has still for sale a number of Bulletins by Albert Howard, C.I.E., Imperial Economic Botanist.

The price is 4 annas per each copy excluding postage.

THE IMPROVEMENT OF FODDER PRODUCTION IN INDIA.

By

ALBERT HOWARD, C.I.E., M.A.

The improvement of cattle in India depends largely on a plentiful supply of good fodder. This fact is now being generally recognized and few people are to be found who believe that any real progress can be made in animal production if the food-supply remains, as at present, a limiting factor. The first step in the problem is to feed the animals which already exist. The creation of new types and the improvement of the present breeds by selection are matters of secondary importance in so far as the cultivator is concerned.

The increased production of fodder per unit area is one of the subjects which has been taken up at the Quetta Fruit Experiment Station. In order to get the land into condition for fruit and also to provide a cover-crop between the rows of young trees, various annual fodder plants have been tried. Of these, Persian Clover or *shaftal (Trifolium resupinatum)* has proved the most satisfactory. This is a rapidly growing annual which can make use of the winter rains and which gives a large amount of fodder, the last crop of which forms an excellent green-manure. An account of the cultivation of this crop and of the preparation of clover hay has already been published.* In the present note, the best method, so far discovered, of inducing the crop to give the highest yield per acre is dealt with.

---

* Clover and Clover hay, *Bulletin No. 5, Fruit Experiment Station, Quetta*, 1915 (reprinted in the *Agricultural Journal of India*, vol. XI, p. 71, 1916).

Where the irrigation water is limited, as at Quetta, two means of increasing duty of water in fodder growing have been found successful. In the first place, crops like *shaftal* grow faster and need less water if the land is manured in the first instance with farm-yard manure at the rate of about fifteen to twenty tons per acre. The manure apparently increases the aeration of the soil for the benefit of the root nodules and the effect on the soil is not lost in subsequent years. Indeed the growth of the *shaftal* improves the fertility and the second year's crop without manure is better than the first. The second method of making the water go further is the proper grading of the surface so that the irrigation water flows evenly over the land. In such fields long narrow *kiaris* about 300′ × 25′ can be watered easily from one end from a well-made, turfed distributary. The expense and trouble in grading and levelling and in the adoption of the most suitable form of *kiari* is well repaid by the amount of water saved, by the ease with which irrigation can be carried out, and in the evenness of the resulting crop.

During the past season, one of the plots at Quetta which was not in very good condition was put down in *shaftal* in August, 1915. The land was manured with farm-yard manure at the rate of about 20 tons per acre sown with *shaftal* under a thin cover crop of maize. The area of the plot was 0·6735 acres and five cuts were taken as follows:—

	lbs.
1. First cut on October 18th, 1915 ...	1,325
2. Second cut on December 2nd, 1915	4,185
3. Third cut on March 14th, 1916 ...	6,040
4. Fourth cut on April 20th, 1916 ...	12,730
5. Fifth cut on May 19th, 1916 ...	13,737
Total of five cuts ...	38,017

The last crop, which was about the same as the fourth or fifth in weight, was not harvested as this particular plot was kept for seed. Taking this at 12,000 lbs., the total of the six cuts would have amounted to 50,017 lbs. of green fodder. This works out at 33·15 tons per acre per annum. At eight annas per 100 lbs.

the year's produce would be worth Rs. 371 per acre, an income obtained with the minimum expenditure of water and resulting in an increase in fertility. This result, which has been confirmed many times at Quetta, indicates the methods which should be adopted in fodder growing in India—intensive cultivation combined with the minimum expenditure of irrigation water. It is probable of course that still heavier manuring would give more cuts and more produce per cut. This has not been tried up to the present as the supply of farm-yard manure in the Quetta valley is limited and there is no great point in discovering improved methods which cannot possibly be applied.

DAIRY FARM MANAGEMENT IN INDIA.

BY

MEOLICAN.

DAIRY TECHNOLOGY—(*continued*).

DISTRIBUTION of dairy produce is one of the most difficult undertakings a manager of a dairy meets with in India. This is especially so. Several excellent articles on this subject have been published in our Journal from time to time (see pages 115 and 283, Vol. I, also see page 152, et seq.) of Dr. Joshi's book "Milk Problem in Indian Cities."

Undoubtedly the introduction of the new American Bottle and Capping system is a great advance in overcoming the delivery problem, but the cost is very heavy, and unless the customer is prepared to pay for the improvement, it becomes almost prohibitive. There are rarely sufficient customers in a small radius to make it profitable to deliver, but it must be done even if it is unremunerative. It therefore becomes a problem of how to overcome distances with the least possible expense. Many methods have been tried, *i.e.*, motor lorries, tricycles, carts drawn by mules, ponies and horses, hand carts, etc., but so far no very economical system has been evolved. The motor lorry with distributing depôts would appear the most promising method.

The deliverymen at present employed on most farms are simply looking out for every possible opening to steal, many methods have been tried to frustrate them, and I think they are now nearly at their wits ends; since the new bottle and other methods have been introduced, but it is possible that they will not now serve without higher wages, which perhaps must come in the near future.

Creameries at a near date will probably be much more numerous in India than now, they are undoubtedly very urgently needed in the great milk-producing centres to replace the many insanitary dens now used for butter-making in such districts. The Local Government are looking into these matters now, or rather the Sanitary Commissioners with them are, and one or two improved creameries now in existence might look to the possibilities of extending their sphere of operations.

The collection of cream from villages is unsatisfactory and no self-respecting firm collects cream, except from milk separated in the creamery, and fresh, so that it may be pasteurised before being made into butter.

The manufacture of butter from over-ripe cream is just where one fails to get perfect butter, and if great care is not taken in the collection of fresh cream, its pasteurisation, perfect ripening, and correct temperature in churning, it is impossible to manufacture factory butter of a good quality.

Except in a well-equipped creamery, it is not possible to obtain good results, especially in India where we have high temperatures to contend with; a small butter-maker without up-to-date plant therefore cannot put on the market a wholesome and well-made article.

It is true he can undersell the better-equipped creamery, since he can put his produce on the market at a lower price. The average customer, unaware of the danger he is liable to incur, pays the lower price, and it is here that the modern creamery is handicapped. The inspection of butter-making plants by Medical Officers and Sanitary Inspectors would do much to remove this difficulty.

The more one studies the question the more he is convinced that Government were justified in prohibiting produce from unreliable sources being sold in Regimental Institutes of Regiments in India.

It is possible that butter may yet be sent to Britain, it is however necessary that further investigation should be made in the best means of ripening cream to overcome the "tallow" flavour of buffalo fat Most samples of Indian butter have too little water

intermixed, and too much curd. The situation of a creamery should be where most produce is available and in a fresh condition, as near to railway station as possible, so as to save carriage, which is costly where milk or cream is transported long distances by road.

An estimate of the cost of establishing a small creamery capable of handling 1,000 lbs. of butter per day will, we hope, be contributed to the Journal by our chairman, and published in our next issue.

The disposal of sewerage from a creamery is a real difficulty, and undoubtedly the only way is to use it on the fields and crop heavily from it, but if used for this purpose it must be heavily diluted.

It is therefore necessary that a sufficient supply of water is available in an Indian creamery. (See page 106, Vol. II of our Journal, for an article on "Disposal of Creamery Sewerage.")

The disposal of the by-products of a creamery has not been very much studied yet, but there are great possibilities in the casein production of lactose, milk-powder, calf meal, etc. (See page 118, Vol. III of Journal for January.) Where so much whey is being thrown away, pig-keeping in Guzerat might be remunerative, as piggery produce could be remuneratively disposed of in the Bombay market.

We agree with Dr. Joshi's remarks in his recently published book "that under existing conditions it is not generally profitable for private concerns to undertake the production of milk." The practice of purchasing milk from the indigenous producer in rural districts, and sending it to the city for sale has been found to be a lucrative one. In other words it would appear that large commercial dairies generally pay, but dairy farming on a large scale with the existing types of Indian cattle will seldom be found profitable. This must naturally be so, and in fact we see it exemplified in every western country. The farmer is the natural producer, and anything unnatural is generally doomed to failure.

The Bombay Government Milk Committee have to a great extent led the way in propagating the idea and showing how it may be carried out. When milch

cattle can be obtained in India giving 5,000 lbs. per annum dairy farming may be profitable, provided of course that fair market rates can be obtained. Government Dairies in many cases, notwithstanding very heavy charges in connection with bottles, caps, and delivery, have been able to retail pure milk at a lower rate than that charged by private-owned dairies or retailed in the bazaar.

THE PUSA COMMITTEE ON DAIRYING.

By

HAROLD H. MANN, M.A., B.SC.

If the number of committees which have sat during the last three or four years be any measure of the interest which they aroused, then one might think that of dairying in India as of almost supreme importance. There have been committees in Calcutta. Bombay, and I believe, in other large towns. The improvement of the milk supply has been considered by a large committee in the Bombay Presidency. Military committees have on several occasions considered the development of milk supply in cantonments and other military areas. The All-India Sanitary Conference has on two occasions had the subject in an important place on its agenda. And finally at the last two meetings of the Board of Agriculture for India, the question of cattle breeding and dairying has been one of the principal items on the programme.

This was particularly the case at the meeting of the Board of Agriculture held last February at Pusa. This Board, which meets only once in two years, is composed of men from every province in India, who represent the agricultural and veterinary departments and hence, in a measure, the forces making for progress in agricultural and veterinary matters in the various parts of India. Its opinions have great weight with Government, and were it not for the war this year I feel confident that the recommendations there made would have been accepted and carried out, in spite of the fact that the money cost is considerable.

The recommendations of this committee had three essential objects in view. In the first place it was

felt that perhaps the most essential need of the Indian dairying industry was to breed, in each part of the country, a dairy animal which would give a much larger yield than is obtained at present, and which would be as hardy and as suited to the conditions as the dairy animals at present in use. Secondly it was necessary to have means whereby dairying by modern methods could be learnt in its best practice. Again for economical dairying a much better knowledge of Indian foodstuffs and their feeding value would be required. Equally necessary with these for successful dairy development is the protection of cattle in India from the epidemics of disease which so frequently sweep through the country and ruin very many of the best herds. And finally, it was considered that there was little hope of real progress unless, by legislation, honest straightforward dairy practice was protected against the serious adulteration of all dairy produce which is almost universal in the country. These are the essential points: all of them were considered necessary to any real *bonâ-fide* step forward to improve the dairying system of the country.

Perhaps, if one can make any difference, the first of the proposals is that of the most fundamental importance. Until a type of animal is obtained which yields more milk and will, nevertheless, keep healthy is produced, little progress can be made. Most of the breeds of cattle in India, even the best, are only moderate yielders of milk. On the other hand, crossing of these with high milking breeds of Europe or America lead to the production of stock very liable to be carried off by rinderpest or other prevalent diseases. It is evident, therefore, that it is no easy problem to obtain types which will be free from both these disadvantages. More than this, the possibility of improving the milk yield of the buffalo, the milk animal *par excellence* of India at present, has never been seriously investigated.

The present seems a very favourable opportunity to take up seriously the question of producing types of dairy cattle in India, for there exist now, in the military dairies in various parts of the country herds of pure pedigree stock of most of the dairy cattle breeds of

the country, and the military departments are prepared to place these at the disposal of a comprehensive scheme of improvement. These include herds of Saniwal cattle at Lahore and Ferozepore, and also at Umballa; of Hariana cattle at Lucknow and at Jubbulpore; and of Sindhi cattle at Poona, at Belgaum, and at Quetta and Ruk in Sind itself. Moreover the dairies where they are at present would be prepared to house and manage these herds under a well-devised scheme.

The committee therefore recommended that these herds should be taken over, and that the direction of the whole system of cattle-breeding for milk purposes, using these herds as a basis, should be placed in charge of a special officer, of wide experience in this direction, to be termed the Imperial Dairy Expert. His work, in the direction of breeding for milk, would not be confined to these breeds or to these places. He would work with and test other breeds, produce crossbred animals with dairy points in view, would give buffaloes an important place in his programme, and would establish new centres in other parts of the country as various considerations demanded.

This would be the primary work of the Dairy Expert, but he would also probably be able at least to exercise an inspecting supervision over the system of dairy instruction recommended, to organise inquiries into the existing dairy methods in different parts of the country, and the possibility of the establishment of the industry on a commercial basis, and to act as general adviser on dairy matters to provincial governments as well as private people who needed help in this direction.

While the breeding of better milking strains of cattle and buffaloes which will keep healthy in the country is the most vital point in the committee's scheme, it was generally recognised that there are other most serious hindrances to development at present. The first of these is the impossibility of obtaining training in modern dairy methods or in their application in large dairies. To meet this it was proposed to establish two dairy schools, on slightly different plans, one at Poona and Kirkee in connection with the Poona Agricultural College and the military dairy farm at Kirkee, and the other at Lucknow in connection with

the military dairy farm at that place. The first of these, it was proposed, should be organised in connection with and under the control of the agricultural college at Poona. The students would reside on the military dairy farm, where additional staff would be provided for the practical instruction of the students. At Lucknow the whole organisation would be arranged at the military dairy farm. A course of two years would be offered, presupposing a good general education. Some part of the course might, moreover, be taken at other suitable centres such as Nagpur or Coimbatore. Either this or some similar scheme would seem to be an essential factor in any real progress in dairying.

Of the other proposals perhaps the most immediately vital is the serious tackling of the question of legislation against adulteration. The committee were unanimous as to its importance, for to everyone who has inquired into the conditions of dairying here, the present situation appears as a crying scandal. An honest man can hardly afford to enter the trade, and until there is some protection for straightforward dealing, dairying on a sound basis can hardly flourish The committee did not suggest what such legislation should be, that was perhaps hardly within their sphere. But they felt that protection there must be, and that, without this, all the remaining improvements would go for little or nothing.

A word is perhaps essential on the other two proposals which were considered as almost equally vital with those already dealt with, namely the immunisation of all cattle connected with the scheme from disease by inoculation, with the hope that through them these methods would become general among dairy cattle in the country, and an investigation of the feeding of cattle in India. The former of these, it was proposed, should be undertaken by a special staff in connection with the Government bacteriological laboratory at Muktesar. This laboratory, the work of which has been of such immense importance in the past to all veterinary development in India, would become a still greater centre of usefulness and a still more vital factor in the country's progress if the recommendations of the committee are carried out.

The proposals with regard to the feeding of cattle in India seems equally vital. No one who has attempted to build up a ration for dairy cattle here can have but felt the inadequacy of the data available to enable him to do so. When one compares the condition of things here with those, for instance, in the United States where the actual value of every available feeding stuff has been tested, not only by analysis, but, in most cases, also by feeding and digestibility trials, the backward state here is emphasised very greatly indeed. Without such data economy in dairying cannot be carried to its last limit. A study, therefore, of the feeding stuffs of India would seem vital for real progress in economical dairying.

Such is, in outline, the scheme recommended by the committee. It is evident that to carry it out in its entirety a great deal of money will be required. The committee place the capital cost at Rs. 1,70,000, and the annual recurring cost at Rs. 2,79,000. Of this latter sum, the amounts (to the nearest thousand rupees) are allotted as follows :—

	Rs.
Imperial Dairy Experts, Staff, and organisation ...	28,000
Dairy Schools	25,000
Breeding Department	1,86,000
Disease Protection Department	19,000
Department for Study of Feeding	21,000
TOTAL ...	2,79,000

This cost is high, but the results to be attained are correspondingly high. If the average yield per milking animal in India could be increased by one seer of milk per day without increasing the cost for feeding, the value of the produce and of the stock itself would make this cost appear as little or nothing. And this result, and far more than this result, is not only possible, but, I think, is exceedingly probable. For this reason I am enthusiastic about the scheme laid down by the committee and endorsed by the Board of Agriculture. I only hope that nothing will prevent its early conversion from a scheme into a reality.

SOURCES OF CONTAMINATION OF THE MILK SUPPLY.

BY

N. S. GIBSON.

When speaking of contamination of milk, we refer to the mixing of undesirable germ-life with the milk, and the way in which it gets there. The first place in which milk can be contaminated with those germs harmful to human life or undesirable from a dairyman point of view, is within the milk-producing organs of the cow, *i.e.*, the mammary glands, udder, etc. Any disease from which the animal is suffering, that is capable of being spread by germs, is carried by the blood stream into the mammary system and there passes into the milk ; such diseases as tuberculosis, etc., is spread in this manner through the medium of milk from the animal to human beings. Animals should be supplied with perfectly pure water, because, should the water be impregnated with disease-germs, as it may be, and sometimes the cow upon drinking the water pass the germs into her system, although she may not suffer herself from the presence of the germs, she may pass them on to human beings in the milk, to whom they may be harmful.

Any animal suffering from disease should at once be separated from the milking herd, and should she continue in milk, this should on no account be used.

Next, dirty cows may cause milk to become contaminated. In exercise yards, fields, jungle, and pools of stagnant water, animals come into contact with air, water, and filth-born germs. These germs cling to the hair on the animal's body, and unless the animal has a

thorough grooming some time before milking, the germs find their way into the milk during the milking process.

The next point to be considered is the cleanliness of the milker. He should be healthy and should not on any account be allowed to milk if suffering from any disease, otherwise he may easily pass germs into the milk by contact. Milkers should be perfectly clean in every way · clean clothing should be kept and put on for the time of milking, and not used for any other purpose, milker's hands must be very clean and should be washed after milking each cow; finger-nails must be kept short, as long nails provide a harbour for microbes.

It is most important that the milkers should wash their hands after milking each animal with the view of preventing the spread of disease from one animal to another through the agency of the milker's hands.

Milking vessels, cans, and other receptacles in which milk is transported should be carefully cleaned at once after use, warm water being first of all used, afterwards scalding may be carried out to kill germs. Milking pails, etc., may be placed in the sunlight, as this is the best of all germ-destroyers. The least number of times milk is handled between the cow and the consumer, the least number of germs will it collect.

Cattle-sheds are frequently hot-beds for the breeding of bacteria; corners where dirt and dust may collect, where sunshine may not penetrate, or fresh air circulate, form an ideal place for the rapidly multiplying germ.

This gives us ample reason for daily washing and cleaning, and frequent whitewashing of walls and roof, so that with clean cows, clean milkers and surroundings, and milking vessels, we may expect to turn out from our cattle-yard, that great factor in human life—clean milk.

Leaving the place where the milk is produced, we next go to the dairy. This should be, and generally is. a place where the rules of cleanly handling of milk are observed.

On receiving milk from the cattle-yard, the first process to be carried out is careful filtering or straining. The milk is passed through a strainer, fitted with a layer of cotton-wool between two removable gauzes. The cotton-wool discs are cheap, and should

only be used for a small quantity of milk, being replaced by a new one as soon as it collects a fair amount of dirt.

This filtering process removes practically all the dirt, and it is almost past belief to see the quantity of dirt that collects in milk carelessly handled in the cattle-yard.

In such a hot climate as India, milk must be pasteurised and cooled if it is intended for transport or for anything but immediate consumption. In any case cooling should be carried out to as low a temperature as possible, to ensure its keeping qualities for a longer time than milk not so treated.

With the use of the pasteurising machine, however, we have the advantage of killing disease and other germs that feed on the constituents of milk, and driving other germs into the spore condition; then in conjunction with pasteurisation, the use of cold water and brine coolers and finally a cold store brings the temperature down and keeps it below the minimum standard necessary to germ-life.

In the dairy as in the cattle-yard, workers should be healthy and clean, all vessels clean and free from congealed albumen, etc., which may collect in the gauzes of strainers, ridges of pails, and milk vessels, especially if very hot water is used in the first washing of utensils, the heat causing the albumen in the milk to coagulate and form a hard cake in the ridges, joints, etc., of vessels which is very difficult to remove. Likewise, the floors and surroundings should be kept exceedingly clean for the reason that, wherever dirt is, the microbe is there also.

Flies must be prevented from coming into contact with the milk, and must be excluded from the dairy by wire gauze doors and windows, and if they do enter must be killed by means of fly traps, flappers, or any other means. Milk must be transported to customers by road or rail in closed vessels and in clean surroundings. An instance came under the writer's observation a short while ago, where churns of milk were packed in a goods-van, in which dogs, chickens, etc., also travelled.

Milk should receive careful treatment at the hands of the purchaser when delivered by the dairy delivery

man, otherwise all the care that has been used in the endeavour to produce a pure product will be thrown away and count as though it had never been. Clean jugs and vessels should be used, and if all the milk is not used immediately, vessel containing the milk should be placed in a basin of cold water and covered with a piece of muslin. Even better is the use of a small ice-box.

In the production and handling of milk, cleanliness is the rule that everyone should obey and enforce with utmost rigour, and is the only way in which we can combat the spread of contagious diseases by means of the milk-supply.

RECLAMATION OF "KALLAR" LANDS.

In former experiments, salt bushes and grasses were imported from America and planted. Success was not attained, however, in these experiments. It has always been known that "kallar" spreads with increasing irrigation; and that it could be washed out temporarily with an excess of water, only to get worse again afterwards. This problem was sent to Mr. Barnes, the Punjab Agricultural Chemist, and the following is a summary of how he has successfully solved it:—The saline matter which whitens these lands consists of mixed sulphates and chloride of soda, magnesia, and lime. These salts result in the first place from the weathering of soil particles by heat and cold by water and solvent action of carbonic acid. A close examination of the facts, both by laboratory and by field methods, revealed evidence of lateral movement of soil water under the influence of differences of soil texture. This results in a difference of capacity for heat by different soils, some soils evaporate moisture quicker than others with the result that lateral movement of sub-soil water is set up and the salts of surrounding fields are collected on the places of excessive evaporation.

Having established the theory that the cause of the formation of "kallar" soil is the uneven movement of lateral water due to uneven evaporation, Mr. Barnes proceeded to find out the cure.

With the sanction of the Punjab Government an experimental farm was established at Narwalla, eleven miles from Lyallpur. The land selected was the worst "kallar" land in the district within easy reach of Lyallpur. The total area taken up was 131 acres, of which 48 acres was entirely barren. The object Mr. Barnes set before himself was to reverse the movement of underground lateral water by a system of drainage deep enough to get hold of the main body of salts which cause sterility. Laboratory experiments had already shown that the salts were not poisonous, and that if the excess could be removed the bacterial flora normally

found in fertile soils would at once begin to make their appearance.

The water table here is 70 or 80 feet below the surface and the use of any ordinary drainage system was out of the question. The ground had to be levelled most carefully. This was an expensive, troublesome but quite essential preliminary, operation. The drainage on the Narwalla farm was done with machinery and steam tackle. Mole drains, 3 feet under the surface and 2½ inches in diameter, were made with special machinery, the holes terminating in deep ditches cut through the farm. It is at least possible that the mole draining was not a necessary part of the scheme. The whole of the land was dug up with a steam cultivator to a depth of 18 inches, and the surface soil thoroughly loosened. Then water was turned on and allowed to soak in. The washing process had to continue for as long as a month, and the amount of water depends on the amount of salt to be removed, and on the nature of the soil. The essential process was to break up the surface thoroughly and then to apply water freely to the surface, and through the deep drains lateral movement of water was set up and the salts were carried down into the sub-soil. The results of the experiment have been completely successful. In the very first year of the experiment, *viz.*, 1915, the average outturn of wheat was nearly 19 maunds an acre, and on some fields rose to over 26 maunds. In the present crop, 1916, the highest outturn has risen to nearly 30 maunds per acre. The average outturn of adjoining zamindar land is ordinarily estimated at 13 maunds, but is less this year. On the other hand, the amount of water used has been nearly three times the amount that an ordinary zamindar could get, and of this rather less than half was used in washing the soil, and the rest for cropping. The financial results of the Narwalla experiments are entirely satisfactory. Roughly speaking, the crops of two years' cultivation are sufficient to pay all expenses of levelling, draining, washing, and cultivating, together with all labour, fuel, hire and depreciation of machinery, over and above the rent of the land. In addition to this, the value of the land is at least doubled.—*The Daily Gazette*, 13*th June*, 1916.

THE UDDER OF THE MILKING COW.

BY

H. G. ASSELLTINE (in the Dairy).

THE cow's udder is a delicate piece of machinery, as sensitive to abuse, ill-treatment, and improper care as a watch. Few dairymen, however, realise this fact—or, if they do, no one could ever detect it by the care they give their cows. To avoid the losses so common in the big dairies, it is essential that the dairyman should know something of the structure of the udder, and the many factors which unite in causing udder troubles, together with some idea of how to combat them.

The udder is composed of two separate halves, the right and left, which are separated by fibrous tissues. There is no connection between the two halves, so that milk cannot be drawn from one to the other. The milk glands proper are located near the abdomen, and extend downward into the udder, the remainder of which is occupied by blood-vessels, nerves, muscles, ducts, and tissues, making it rather open and sponge-like. At the lower end of the teat is the sphincter muscle, which keeps the milk from escaping. Over this the cow has no control whatever. The upper end of the canal in the teat is connected with the milk reservoir, the size of which varies in different cows, the capacity averaging about one pint Extending from the sides and top of this reservoir are a large number of ducts or tubes, called milk ducts. They divide and subdivide to form a chainwork of a very large number of small tubes, and are surrounded by blood-vessels, nerves, and muscular tissue There is a still more complicated network of

division and subdivision, but let this suffice to illustrate the point that, in dealing with the cow's udder, we are working with a very complex mechanism.

With heavy milkers the udder is enlarged, as a rule, and more or less hot and tender just before and after calving. This swelling may extend forward to some extent on the abdomen. This condition is to be expected, and need not cause any anxiety. It is more pronounced when the animal has been well fed and is in good flesh. When this exists, the animal should not receive much grain until the udder softens. The ration should be laxative in nature, and of a light character. Bran is especially adapted for feeding at this time. The milk should be drawn several times during the day after calving, followed by active rubbing or kneading of the udder. Milking before calving is advisable only with the heaviest milkers when they are suffering greatly from the distention of the under.

Congestion of the udder may merge into active inflammation—or garget, as it is often called This usually results from exposure to cold, moisture, draughts, from blows or injury to udder, or from overfeeding of rich protein foods. The cow should be kept from exposure to cold weather and to cold draughts, and off cold, wet floors until congestion leaves the udder. At times there will be only a slight swelling in the udder, which will not interfere with the milk secretion beyond a tenderness. Or the milk may be lumpy and full of threads, with no noticeable hardness in the udder. In severe cases the milk is usually suppressed and replaced by a yellowish, watery fluid, containing clots of casein. The first symptom in these severe cases is a shivering of the animal, with cold ears and horns, followed in a short time by a fever.

Milk-fever is a peculiar affection of the cow, occurring as a form of paralysis, and associated with young cows, but usually after the growth of the cow has ceased and all her energy is devoted to milk production, or usually when she is from five to nine years old. The disease is so typical that it is easily recognised. It occurs in nearly every case within forty-eight hours after calving, and usually only after a normal parturition.

The first indications are restlessness and excitement on the part of the cow. Her gait becomes unsteady, and she gradually loses control of her hind parts, finally falling to the ground. She is usually unable to rise: the cow now assumes a characteristic position, which is a great help in diagnosing the case. She lies with her head turned to one side, with her muzzle toward the flank. The entire body is paralysed, and she expresses every evidence of being in great pain.

While it is possible to stop milk-fever by any means that will fill the udder with air, yet there is danger of introducing infection unless extreme care is taken. But for this fact an improvised outfit could be used. It is well, however, to use a standard milk-fever apparatus, which can be procured for a nominal price. Before using this apparatus, the operator should thoroughly cleanse his own hands and wash the udder and teats of the cow with an antiseptic solution. Then, having the apparatus free from infection, the milk tube may be inserted into the teat without drawing what milk it contains, and the quarter of the udder filled and well distended with air. The tube may then be carefully withdrawn, and a tape tied around the teat tightly enough to prevent the air escaping. The same treatment is applied to each quarter. The udder should remain full of air for at least twenty-four hours—longer, if there still is sign of trouble. The tape may be removed and another treatment given in case the air has escaped. Of course, the calf has had to get his meals elsewhere during this treatment.

Chapped teats may be caused by anything that irritates them—as, for example, the sudden chilling of the teat in winter after the calf has just let go, milking with wet hands, or contact with cold dirty water. The trouble may be slight, or it may develop into deep, gaping sores. The use of vaseline at the first sign of trouble will usually check and cure it. If the teats are badly chapped, thorough washing in warm water, followed by application of glycerite of tannin or equal parts of spermaceti and oil of sweet almonds, is advised.

Warts on the teats are often troublesome in milking, besides adding to the danger of increasing the possibility

of contaminating the milk through infectious material which may be found on them. They may be greatly benefited or entirely removed by smearing them thickly with pure olive oil. If they are large, and still persist despite this treatment, they may be cut off with a sharp pair of scissors, and the spot touched with a stick of caustic potash. They may be oiled now, and the caustic potash treatment repeated as often as necessary to prevent their renewed growth.

Too small an opening in the teats is the most common cause of hard milking. The size of the opening is controlled largely by a strong sphincter which closes the teat opening more than it should normally. Anything that will cause this muscle to contract slightly and the opening to remain larger, will, as a rule, make hard milkers easier to handle. Often lead or rubber teat-plugs are placed in the teat duct and fastened there, so the cow wears them from one milking to another, this treatment in time curing most hard milkers.

In some cases this treatment is not sufficient, and the only cure is to cut the teat on the inside with a teat bistoury. This instrument is passed into the teat canal, and, by means of a turn of the handle, a small knife is projected. As the instrument is removed it cuts the side of the teat duct and the surrounding muscles. An ordinary teat-plug is then kept in the teat, except in milking, until the cut heals. This is a rather dangerous operation, and, because of the likelihood of infection, it is best to call a vet.

THE MILKING MACHINE IN INDIA.

BY

H. ST. JOHN.

In several Indian periodicals and journals we have noticed lately articles advocating the advisability of the introduction of "Milking Machines" into India.

From a perusal of the Home and American periodicals, and reports of trials of the machines, there is no doubt that within the past two or three years many important improvements have been added which greatly tend to increase their efficiency.

There is no doubt in the minds of experts that the milking machine has come to stay, and that its use will in the future supersede to a great extent milking by hand labour.

From the Home reports there would appear to be two schools of opinion regarding their utility: those in favour of their use have undoubtedly good reasons for their opinions derived from experience gained from actual working conditions; those against the introduction of these machines also arrive at the conclusions in the same way and possibly with the same machines as those reported favourably on by those in favour of them.

Practically all the failures are traceable to some physical characteristic of the cow or incompetence of the operator, a want of knowledge of the working conditions of the plant, and careless manipulation of the working parts, and incorrect adjustment of the machine.

Without the co-ordination of the operator the results must inevitably end in failure.

It is therefore necessary that the operator should thoroughly study his machine and harmonize its working to suit the individuality of the cow. The milk is secreted in the mammary gland and is a natural function not controlled by the cow or the operator.

The secretion of the milk is connected with the nervous system of the cow which the milking operator may affect but not control.

If the animal is frightened, or roughly handled, it must affect the secretion of the milk, and although in isolated cases this would probably have only a temporary adverse effect on the yield, if continued, normal yield would not be obtained.

There is also another most important point to be studied. The flow of the milk from the upper to the lower part of the udder is controlled by the cow. The secretion of the milk in the mammary gland is chiefly in the upper portion of the udder.

The reservoir for the milk is just above each teat, connected by a system of tubes or vacuoles. These are servers to conduct the milk to the cow's udder. The milk ducts branch and rebranch, the opening and closing being controlled by the cow.

If the machine is badly fitted or controlled and the cow suffers discomfort, she will hold up the milk, thus causing longer time to strip her, or if not thoroughly stripped, will eventually cause her to dry off.

The individuality of the cows is another important factor in the milking machine use. In the first part of the lactation period the animals are almost nearly all alike.

As they advance in the milking period the animals develop peculiarities and characteristics which the operator must closely study, and adapt his operations to meet them.

It is most important to see that the teats are in normal condition before putting on the teat cups, so that the cups get a straight and proper grip on the teats.

The pulsator should be worked to meet the characteristics of the cows, and not at a uniform speed for each and every animal.

Then, again, some cows give their milk more rapidly than others, and so to ensure the success of such operations it is necessary to give these few points very careful attention.

To those dairymen in India considering the advisability of the introduction of these milking machine it is most emphatically pointed out that the most careful study in the working conditions is absolutely

necessary. In India we often consider that the introduction of machinery requires very little care beyond the starting and closing operations. We consider that when these points are properly carried out no further need of adjustment, control, and adaptability to local conditions are necessary.

The machine or plant is then condemned as being useless, whereas in the hands of a careful and intelligent operator success with the same machine is assured.

With the introduction of these machines into India, it must be remembered that the cow is not an inanimate object, but a living individual requiring control and careful consideration of her characteristics and peculiarities.

The conditions of Indian labour make it certain that sooner or later the milking machine will be introduced into India, and its introduction will be in time a great factor in the dairying industry of this country. The difficulty of obtaining really good milkers is more apparent year by year. The *gowalla* we knew a few years ago, whose forefathers were milkmen for generations, is dying out. The younger generations are taking up other employment in the large cities of the Empire.

It will therefore be absolutely necessary in large dairies to train men to milk, and when that time comes it will be profitable to look around for some other addition to take the place of hand milking The milking machine adopted to Indian condition will then force its way to the notice of the Indian dairyman.

To ensure success the introduction should be gradual, taking a few cows at a time, and continuing until all the various points in good working are thoroughly mastered.

To instal a machine in an Indian dairy and expect success from these machines within a few hours of its installation will undoubtedly cause failure and the introduction on a large scale of a really excellent method of economical working must be delayed.

As a trial machine is to be installed in India shortly, we hope to be able in a subsequent issue of this journal to give some reliable data on the working of these machines, under Indian conditions, and with Indian animals.

HORSE SENSE.

"Horse sense in verses tense" is a little volume by Watt Mason about life in general (Duckworth, 2*s.* 6*d.* net). His "verses tense" are rhymed prose, and the brevity of his messages adds to their vigour.

Mr. John Masefield says that he finds in them "the qualities I liked so much in my American friends." Here are some samples, each complete :—

The Milkman.

"The milkman goes his weary way before the rising of the sun ; he earns a hundred bones a day, and often takes in less than one. While lucky people snore and drowse and bask in dreams of rare delight, he takes a stool and milks his cows, about the middle of the night. If you have milked an old red cow humped o'er a big six-gallon pail, and had her swat you on the brow with seven feet of burry tail, you'll know the milkman ought to get a plunk for every pint he sells ; he earns his pay in blood and sweat, and sorrow in his bosom dwells, as through the city streets he goes, he has to sound his brazen gong, and people wake up from their dose, and curse him as he goes along. He has to stagger through the snow when others stay at home and snore ; and through the rain he has to go, to take the cow-juice to your door. Through storm and flood and sun and rain, the milkman goes upon the jump, and all his customers complain, and make allusions to his pump. Because one milkman milks the creek, instead of milking spotted cows, against the whole brave tribe we kick, and stir up everlasting rows. Yet patiently they go their way distributing their healthful juice, and what they do not get in pay, they have to take out in abuse."

BREEDER'S TABLE.

Time of Service.		MARES 340 days		COWS 283 days		EWES 150 days		SOWS 112 days		BITCHES 63 days	
Jan.	1	Dec.	6	Oct.	10	May	30	April	22	Mar.	4
,,	8	,,	13	,,	17	June	6	,,	29	,,	11
,,	15	,,	20	,,	24	,,	13	May	6	,,	18
,,	22	,,	27	,,	31	,,	20	,,	13	,,	25
,,	29	Jan.	3	Nov.	7	,,	27	,,	20	April	1
Feb.	5	,,	10	,,	14	July	4	,,	27	,,	8
,,	12	,,	17	,,	21	,,	11	June	3	,,	15
,,	19	,,	24	,,	28	,,	18	,,	10	,,	22
,,	26	,,	31	Dec.	5	,,	25	,,	17	,,	29
March	5	Feb.	7	,,	12	Aug.	1	,,	24	May	6
,,	12	,,	14	,,	19	,,	8	July	1	,,	13
,,	19	,,	21	,,	26	,,	15	,,	8	,,	20
,,	26	,,	28	Jan.	2	,,	22	,,	15	,,	27
April	2	March	7	,,	9	,,	29	,,	22	June	3
,,	9	,,	14	,,	16	Sept.	5	,,	29	,,	10
,,	16	,,	21	,,	23	,,	12	Aug.	5	,,	17
,,	23	,,	28	,,	30	,,	19	,,	12	,,	24
,,	30	April	4	Feb.	6	,,	26	,,	19	July	1
May	7	,,	11	,,	13	Oct.	3	,,	26	,,	8
,,	14	,,	18	,,	20	,,	10	Sept	2	,,	15
,,	21	,,	25	,,	27	,,	17	,,	9	,,	22
,,	28	May	2	March	6	,,	24	,,	16	,,	29
June	4	,,	9	,,	13	,,	31	,,	23	Aug.	5
,,	11	,,	16	,,	20	Nov.	7	,,	30	,,	12
,,	18	,,	23	,,	27	,,	14	Oct.	7	,,	19
,,	25	,,	30	April	3	,,	21	,,	14	,,	26
July	2	June	6	,,	10	,,	28	,,	21	Sept.	2
,,	9	,,	13	,,	17	Dec.	5	,,	28	,,	9
,,	16	,,	20	,,	24	,,	12	Nov.	4	,,	16
,,	23	,,	27	May	1	,,	19	,,	11	,,	23
,,	30	July	4	,,	8	,,	26	,,	18	,,	30
August	6	,,	11	,,	15	Jan.	2	,,	25	Oct.	7
,,	13	,,	18	,,	22	,,	9	Dec.	2	,,	14
,,	20	,,	27	,,	29	,,	16	,,	9	,,	21
,,	27	Aug.	1	June	5	,,	23	,,	16	,,	28
Sept.	3	,,	8	,,	12	,,	30	,,	23	Nov.	4
,,	10	,,	15	,,	19	Feb.	6	,,	30	,,	11
,,	17	,,	22	,,	26	,,	13	Jan.	6	,,	18
,,	24	,,	29	July	3	,,	20	,,	13	,,	25
Oct.	1	Sept.	5	,,	10	,,	27	,,	20	Dec.	2
,,	8	,,	12	,,	17	March	6	,,	27	,,	9
,,	15	,,	19	,,	24	,,	13	Feb.	3	,,	16
,,	22	,,	26	,,	31	,,	20	,,	10	,,	23
,,	29	Oct.	3	Aug.	7	,,	27	,,	17	,,	30
Nov.	5	,,	10	,,	14	April	3	,,	24	Jan.	6
,,	12	,,	17	,,	21	,,	10	March	3	,,	13
,,	19	,,	24	,,	28	,,	17	,,	10	,,	20
,,	26	,,	31	Sept.	4	,,	24	,,	17	,,	27
Dec.	3	Nov.	7	,,	11	May	1	,,	24	Feb.	3
,,	10	,,	14	,,	18	,,	8	,,	31	,,	10
,,	17	,,	21	,,	25	,,	15	April	7	,,	17
,,	24	,,	28	Oct.	2	,,	22	,,	14	,,	24
,,	31	Dec.	5	,,	9	,,	29	,,	21	March	3

BY THE WAY.

Test for Acidty in Soil.

To determine whether or not the soil is acid, use the ordinary litmus paper test. Five cents worth of blue litmus paper, which can be purchased at any drug store, will be more than enough for the test. Take a ball or lump of damp soil from the abovementioned field and divide it in two parts. Put these two parts together again with a small strip of the litmus paper between them. Examine at the end of five or ten minutes, and if the paper or part of it has turned pink, the soil is acid. Repeat this test several times, using soil from different parts of the field. If the soil proves to be acid, it should, of course, be limed, using two to four tons of ground limestone per acre.—*Hoard's Dairyman.*

***

Plant Food.

One thing is certain : if you take plant food out of the soil you must sooner or later return it, or suffer the consequences. We are told that the average soil contains sufficient natural fertility to last for many years, but the problem of making available that dormant fertility to an extent sufficient to grow payable crops indefinitely, without resorting to manure of some kind or other, has not yet been solved. Among other things electricity has been put forward as one of the cures for run-down soils, but although it may act as a stimulant for the time being, it cannot take the place of plant food, and will in the end leave the soil poorer than ever, for no form of life can live and thrive on stimulants alone.

VALUE OF SEWAGE SLUDGE.

It would appear, therefore, that sewage sludge, however formed, has a certain manurial value, and this value is usually increased by extracting the grease of the sludge. To render it marketable it is necessary to dry the sludge to reduce to a minimum the cost of carriage, also to powder it in order that it may be readily incorporated with the soil. The heat used in drying is helpful in killing seeds of weeds and disease germs.

It therefore remains to be discovered what is the most economical method of drying and disintegrating sludge, so that a manure is produced which will pay for its preparation, and, at the same time, return profitably to the soil a certain percentage of the essential elements of which it is deprived, to grow food for man.—*Journal of the Board of Agriculture.*

*
* *

MANURE FOR MAIZE.

Those farmers who intend sowing maize as a fodder crop should see that the land is well manured, as this heavy-yielding crop naturally makes big demands on the soil. If a dressing of farmyard manure was given in advance of sowing, all that is wanted at seed time is 2 cwt. superphosphate per acre, followed bv a top-dressing of $1\frac{1}{2}$ cwt. nitrate of soda after the crop is up. Failing any yard-manure, the dressing at seed-time may be 4 cwt. of a good nitrogenous guano, or a mixture of 3 cwt. superphosphate, 1 cwt. sulphate of ammonia, and, on light land, 2 cwt. kainit, followed by the top-dressing as before.—*The Dairyman.*

*
* *

Agricultural labor and wages in Western India G. F. Keatinge (*Agricultural Journal of India,* 10 (1915), *No.* 3, *pp.* 231—236).—The author states that the Deccan peasant has been accustomed to periods of enforced idleness and the conditions of intermittent labor, which produce a condition of apathy and helplessness which acquires the rigidity of a race characteristic. He considers it probable that the rising standard of living and the increased facilities for obtaining remunerative labor will, in the future, do much to

correct this. His article cites instances of how this change is taking place.

***

Stones in Soil.

Stones in the soil tends to increase the fertility by preventing the too rapid evaporation of water. They raise the temperature of the soil, which, from a plant-growing point of view, is an advantage. Land that is very stony, however, is not in the best state to till; but when the stones are well buried in clay soils, they are decidedly advantageous.

***

Sudan Grass.

We have received many inquiries as to the value of Sudan grass as a feed for stock. This grass is grown at the Queensland Agricultural College, and there it is considered to be a valuable fodder. We understand that in Southern Illinois (U.S.A.), it is classed as a forage plant and for its kind ranks high, although comparatively little is known about it. Sudan grass grows upright in long slender stems, reaching about 5 ft. in height. It is stated by the "Breeders' Gazette" that wherever oats will grow Sudan grass will eventually take its place. It will grow on any kind of soil, but prefers a clay sandy soil. It is more difficult to care for than Timothy on account of its very rank growth. One of its chief values as a feed for horses and cattle lies in the fact that it is very palatable. When fed to either they clean it up thoroughly, showing that they relish it, although it is an entirely new feed to them. This fact alone is always of interest to farmers and feeders. On a $\frac{1}{2}$ acre plot the first cutting made at the rate of $1\frac{1}{2}$ tons to the acre, and in just three weeks the second cutting made practically the same, and there will still be one more crop. Sudan grass is not well adapted for a wet season, such as Illinois has been having this year. On one place it almost drowned out but this ground was exceptionally wet, and therefore the conditions encountered were not average. In dry years or in

average years Sudan grass will produce twice as much as any of the common forages, such as oats, barley, millet, and corn (the latter when used as a forage). Taken as a whole Sudan grass is destined to be one of the greatest hay and forage crops in this country, mainly because it has almost all the good qualities of the best, plus greater production. Sudan grass is an annual belonging to the sorghum family, but, in appearance and in the quality of the crop produced, it is, for all practical purposes, a grass. Since it is an annual and requires seeding every year, the same as other sorghums and millets, there is no fear of its becoming a pest like Johnson grass. Sudan grass has no underground root stocks.—*Queensland Agricultural Journal.*

*
* *

Sunflower Growing for Seed.

The sunflower will grow in almost any soil and in any climate. It will bear cold or heat, drought or rain. It is subject to no disease, and to no climatic disqualification. The cultivation is very simple. As stated, the plant is not at all particular, but prefers light, rich, well-drained soil. It is advisable to sow early—say, the beginning of September—to secure perfect maturity. The quantity of seed required per acre will vary from 4 to 6 lbs. It should be sown in drills, 5 ft. between the rows, and the seed drilled or dibbled in at intervals of 3 ft. The plants may afterwards be thinned out, if found necessary owing to exuberant growth, to ensure full exposure to the sun—a very necessary condition. As the plants have a habit of spreading their branches and heads in successive layers over each other, thinning is generally necessary. When 12 in. high, a slight earthing up benefits the plants Sunflowers with many heads do not ripen the seed evenly, therefore, it is better to cultivate a species producing only one large head to each plant.

The Tall Mammoth Russian is such a variety, and may be planted closer. It produces more seed than any other sort, and can be obtained from most seedsmen in Brisbane, and probably elsewhere.

A yield of 50 bushels per acre is not uncommon under favourable conditions. The Mammoth or Giant Russian has often produced flower heads 15 in. in diameter and bearing over 2,000 seeds.

The leaves of the sunflower, when sun-dried and pounded, and mixed with meal or bran, make good fodder for milch cows. The oil expressed is almost equal to olive oil.

We are not sure of the wholesale price now ruling for the seed; before the war it was quoted at £12 per ton.—*Queensland Agricultural Journal.*

* * *

Food Influence on Milk.

The milk of all classes of farm animals contains considerable proportions of albuminoids, fats, and carbohydrates, says a writer in a recent leaflet issued by the Board of Agriculture. These materials are manufactured by the animal from ingredients of the body, which obviously must be replaced by feeding if the "condition" of the animal is to be maintained. The production of milk-fat and milk-sugar can be sustained by supplying oil and carbohydrates in the food, but only albuminoids will serve for the production of the albuminoids of the milk. The effect of food on the yield and composition of milk demands notice. Up to a point, which varies greatly in different animals of the same class, any food given in excess of the minimum necessary for "maintenance" is utilised for purposes of milk production. When the food-supply is steadily increased, however, the point referred to is reached sooner or later, beyond which there is an increasing tendency for additional food to promote fattening rather than to increase the flow of milk. The percentage composition of the milk yielding by a particular animal is largely independent of the nature of the food supplied. Provided that the ration is such that it maintains the milk yield and general "condition" of the animal, the composition of the milk can in general be but little affected by change of food.—*The Dairyman.*

Important Points in Drying Off a Cow.

The cow should be rested for six or eight weeks before calving, in order that she may produce a vigorous calf, and milk well during her next period. Strict records of the periods of gestation should, therefore, be kept, and tables for this purpose are easily obtained. In drying-off some care is necessary. The usual practice is to milk them only once a day for a time, then once every second day; and finally, once every third day until dry, at the same time cutting off milk-producing food. It is essential that the cow should be milked dry each time, otherwise bacteria may gain entrance and set up trouble in the accumulated fluid, which often ends in caked udder, loss of quarter, etc. The milk when drying off should be boiled and fed to pigs, and not used for human food. In the case of good milking cows, it is essential that they should produce calves each season to build up the herd; but only if bulls of known milking strains are employed. Where one or two cows only are kept the lengthening of the milking period is a matter of some consideration. I have known cows to milk for 20 months, and have seen others reputed to keep in profit for much longer periods. Such animals are invaluable to suburban residents as they freshen up each spring, and can be induced to give ample supplies by judicious feeding. The habit is one that seems to increase in duration by encouragement —*The Dairyman.*

***

The Value of the Sire.

We all know that "the sire is more than half the herd," and that very great care should be exercised in the choice of such an animal. A sire, many of whose near relatives are great, is more apt to transmit those qualities than an animal having only one or two great ancestors. In the sire we should look for great vigor and character. We should also bear in mind that a sire that comes from a herd that is strongly bred along the line of a fixed type is most apt to be prepotent. We may also expect more from an animal whose sire and dam have proven to be unusually

prepotent than would ordinarily be expected, and it is likely that an animal that is judiciously line bred will be more apt to be prepotent than an animal of more mixed breeding because if the ancestors of the animal in mind have resembled each other he will have a greater tendency to reproduce those qualities. It will also be found that animals of a strong constitution are more apt to transmit their characteristics, other things being equal, than are animals of less constitution and vigor.

It will also be found wise to judge of the pedigree, more from the standpoint of the entire family from which the animal comes than from the standpoint of any one great individual. In judging of the pedigree we should remember that good qualities alone add value to a pedigree. "Individual excellence by inheritance" is the thing we should look for in connection with performance.—*The Dairyman.*

*
* *

Pasteurization of milk supplies as a protection against typhoid fever, J. C. Geiger and F. L. Kelly (*Jour. Amer. Med. Assoc., 66 (1916), No. 4, pp. 263, 264, fig. 1*).—An account of a typhoid epidemic in California, evidence being presented to show that in one district where pasteurization was required there were no cases of typhoid fever traceable to the particular milk supply in question, while in the other district where the sale of raw milk was permitted the disease was very prevalent.

*
* *

Bitter Milk.

Bitter milk is one of the most common complaints arising during the spring of the year. This is due to several causes, the most common being flavours due to spring feeds with strong odours. The only remedy is to keep the cattle from infested pastures for at least four hours before milking. Spring flavours due to pasture may be avoided by changing from winter feeds to pasture gradually, allowing ten to fifteen days to make the change.

Milk may have an abnormal bitter taste when far along in the lactation period. This usually occurs

when the animal has been dry fed and appears to be due to her physical condition. This may be remedied and removed by reducing the grain ration and giving two or three doses of Epsom salts.—*The Dairyman.*

*
* *

SAFE MILK. (From the *Dairy World.*)

In looking over a recent copy of your journal I saw a note on the "Home Pasteurisation of Milk," as advocated and interpreted by Dr. H. Kerr, Medical Officer of Health for the City of Newcastle. Far be it from me to criticise the advocacy of or necessity for the pasteurisation of milk, for one cannot but become more and more convinced that other than in exceptional cases the process is desirable, to be recommended, and not unlikely in the near future to be enforced. The aim of hygienists and bacteriologists is at one with that of Dr. Kerr and his brother Medical Officers of Health—to assure a safe and wholesome milk for the feeding of children and for the consumption of adults; and few questions of a civic nature are at the present time more important.

I wish, however, with your permission, to briefly point out and substantiate my contention that advice such as given regarding the pasteurisation of milk in the home, according to the report I read, is unsound, is not in harmony with the latest scientific researches, and is calculated at the hands of the careless and uninitiated to give results of a highly questionable nature. The term pasteurisation is one which is sadly misused, and which may mean anything or nothing. In Germany and some other of the European countries it is interpreted as meaning the heating of milk to a high temperature—176° to 185° F.—for a very short time, followed by rapid cooling. In his "Milk Hygiene" (1914), a most valuable contribution to milk literature, Ernst gives a temperature of 185° F. for thirty seconds. Such certainly pasteurises the milk in so far as it kills the bacillus of tuberculosis, the bacillus of typhoid, and others. But unless consumed within a few hours such milk tends to putrefy rather than sour normally, owing to the failure of this temperature to destroy the spore-forming bacteria normally found in market milk. These

later germinate, and are responsible for the tendency to putrefaction. Further, the temperature used has killed the desirable lactic acid producing bacteria, and the bacterial flora of the milk lacks the restraining and corrective influence of these useful organisms. It is the pasteurisation of milk, at high temperatures, such as this, that has provided the ground for the contention that pasteurised milk, unless consumed within a stipulated time, becomes noxious, and while appearing pure to the eye it is unfit for food. Now, exactly the same takes place when milk is boiled. If the milk be comparatively fresh and it be consumed shortly after boiling, the procedure may be pérfectly safe. The average housewife, however, consumes or uses the milk as it is required, and not necessarily within a stipulated time. The whole question as to the danger or security of such milk depends largely upon the temperature at and length of time for which it is subsequently kept, and for this reason the advocacy of boiling milk in the home, in order to render it safe, is to be strongly deprecated.

The idea of pasteurisation referred to above has been exploded in recent work by leading bacteriologists in the United States within the last five years. Dr Rosenau, Professor of Preventive Medicine and Hygiene, Harvard Medical School, has conducted a great deal of research work on the subject, and he has demonstrated that a temperature of 140° F. for 20 minutes is efficient in destroying such disease producing organisms as the tubercle bacillus, the typhoid bacillus. and many others Further, he has shown that such temperature does not kill all the lactic acid producing bacteria which are normally found in market milk. Ayers and Johnson, of the Washington Government Laboratories, have substantiated this thesis, and in their more recent publications have stated that in order to be perfectly safe a temperature of 145° F. for thirty minutes is sound as a maximum pasteurising temperature. It is above the thermal death point—the temperature at which an organism is killed—of the disease producing germs above mentioned, and at the same time is below the thermal death point of many strains of the beneficial lactic acid producing bacteria. The result of such a system is that after

pasteurisation the "groups" of bacteria surviving are of such nature that some strains of the lactic acid producing organisms predominate, and the milk sours as it becomes aged just as does the raw milk. *This is the modern conception of pasteurisation,* and it will be readily seen that if such a method be followed, the milk dealer or the housewife has subsequently a means of knowing when such milk is undergoing a change.

In the cities where pasteurisation of milk is enforced by law, the milk must be delivered to customer within a stated time after pasteurisation. Full particulars must be given on the bottle relative to the temperature used, the time exposed to the given temperature, the date of pasteurisation, and the name of the one responsible for the process. Until such time as the law enforces pasteurisation, the housewife who wishes to have her milk supply safe and beyond question may do this in the home. Heat for thirty minutes at 145° F., put in a well scalded jug, cover, and keep in the coolest place possible until the milk is required for use. Again, I would say that pasteurisation should be such that it kills any disease producing organisms which may be present, but fails to kill the more resistant strains of the lactic acid producing organisms.

WILFRID SADLER,
DEPT. OF BACTERIOLOGY, MACDONALD COLLEGE,
Province of Quebec, Canada.

January 24th, 1916.

***

FEEDING AND THE MILK YIELD.

We do not yet seem to know what influence the food-supply has on the milk yield of a cow. In a general way a well-fed cow milks well, while a poorly-fed one milks ill, but when we come down to details there is much more about it than that. There is, for instance, the fact that when an animal has a sufficiency of grass, hay, roots, or any other home food, the addition of cake or meal does not increase the yield, and indeed only does good when the other foods are

short. Then, again, while we may possibly influence the quantity of the yield, we cannot control the quality by means of the feeding, no matter how "rich" we may make the food. It is becoming increasingly evident, indeed, that the milk is a product of the animal's body, and only derived from the food secondarily. In other words, the food must first go to build up the tissues of the body and to form fat, blood, and lymph before the materials can be secreted into milk in the udder. This means that a well-nourished body is essential to milk yielding, but the nourishing should have been done beforehand. Some of the immense milk yields reported from America have been obtained by letting a cow go dry and even barren for a long period before the next calving, and thus she gets up in condition a year ahead almost, and this comes out in the milking when she comes into work again. This system has partly been followed in this country by many people between the milking periods. The writer has known farmers who systematically fed well when the cows were dry, and then when they were actually milking they reduced the feed. It was liable to cause milk fever, but apart from that it paid in the extra yield of the cows afterwards. The materials stored in the system of the cows were gradually turned into the milk stream, and they milked far better than those that had been "wintered" sparingly. The control of the composition of the milk—the question of the percentages of solids therein—is as much beyond us as ever; we do not seem to know anything about this as yet; there is only the general fact that, on the whole, liberal feeding will be followed by a liberal milk yield.—*The Dairy.*

***

Defective Udders.

When heifers are coming into work it is desirable to see what sort of milk bags and teats they have. It is indeed desirous to see about this almost immediately after birth before any money and labour are wasted on rearing an animal that may have some mal-formation of these organs. On a calf there is little appearance of a milk bag, but the tiny teats are there and one

can judge if these are set fairly wide apart and will be of reasonable size. A farmer writes in one of the papers to describe a blunder he made in this. He bought a maiden heifer without taking any notice of this point, and when she came in due course to the milk-pail he discovered to his disgust that two of her teats were grown together and could not be milked, and she had to be dried off and fatted for beef and he bewailed his stupidity in not seeing this defect sooner. He had the curiosity to hunt out the relationships of that animal, and found that her mother and sister had the same defect, and that the mother of the sire was also the same way, so that the malformation was hereditary, though worst in his own case. Malformations of various kinds are often hereditary, some of them of no account—like split ears—but others, like this case of bad teats, are of the kind fatal to efficiency in the matter for which they are kept There is, of course, less chance of such things happening now than there used to be, because we are only rearing calves now from our best milking cows, using bulls only of a milking ancestry, and with well-developed though abortive teats themselves, but nevertheless one has only to frequent live-stock sales to see what a surprising number of animals there are in existence yet with mis-shapen udders and teats. As this is the main part of the anatomy of a cow for dairy farming purposes, it is worth while taking notice in time.—*The Dairy.*

*
* *

The Adulteration of Milk.

The Royal Agricultural Society of England are circulating a leaflet on Milk Adulteration, which we reproduce in full for the information of our readers :—

Under an Order of the Board of Agriculture made in 1901 in exercise of the powers conferred on the Board by Section 4 of the Sale of Food and Drugs Act, 1899, milk containing less than 3 per cent. fat and or less than 8·5 per cent. of solids-not-fat "is presumed" for the purposes of the Act "until the contrary is proved," to be "not genuine" by "reason of the abstraction therefrom of milk-fat" or "of solids others than milk-fat, or the addition thereto of water."

To understand this Order thoroughly, a knowledge of the relative proportions of the several component parts of milk is necessary. The following figures give the average composition of milk of good quality :—

	Per cent.	
Water	87·75	
Fat	3 50	
Casein	3·20	Solids-not-Fat 8·75
Sugar	4·40	
Albumin	0·40	
Ash	0 75	
Total ...	100·00	

These constituents are affected by the addition to the milk of water in certain definite proportions as shown below :—

	Genuine Milk.
Percentage of fat	3·50
„ Solids-not-Fat ...	8 75

Milk with added Water.	Fat.	Solids-not-Fat.
95 per cent. milk, 5 per cent. water ...	3·32	8·31
90 „ „ 10 „ „ ...	3·15	7·87
85 „ „ 15 „ „ ...	2·97	7·43
80 „ „ 20 „ „ ...	2·80	7·00
75 „ „ 25 „ „ ...	2·62	6·56

In what is known as the "Government" Standard, the percentages of "Fat" and "Solids-not-Fat" are considerably lower than the figures shown under the heading "Genuine Milk," being only 3.00 per cent. fat and 8 50 per cent. solids-not-fat, and it is on this lower standard, and essentially on the fact that the law requires milk to contain at least 8·50 per cent. of solids-not-fat, that prosecutions have to be based.

The following figures show how, taking the so-called "Government" definition of genuine milk, the fat and solids-not-fat would be affected by the addition of water :—

	Genuine Milk (Government Standard).
Percentage of fat	3·00
„ Solids-not-Fat ...	8·50

Milk with added Water.	Fat.	Solids-not-Fat.
95 per cent milk, 5 per cent. water ...	2·85	8 07
90 ,, ,, 10 ,, ,, ...	2·70	7 65
85 ,, ,, 15 ,, ,, ...	2·55	7 22
80 ,, ,, 20 ,, ,, ...	2·40	6 80
75 ,, ,, 25 ,, ,, ...	2·25	6 37

—*The Dairy.*

***

Uses of Casein.

We Wear and Eat it, Use it in Manufacturing, and Employ it in the Arts.

Arthur Lynch, writing in "Hoard's Dairymen" on the many uses to which casein can be put says :—

The casein of milk is now being extensively used in the preparation of paints, glues, as a fixing agent in the textile industry, as an adhesive in the paper industry, for moulds in the studio, and for combs, buttons, linoleum, ladies' hair pins, and many others, not to forget toys. In this age we have a right to expect great achievement in almost any field, but when we think of using cows' milk for our clothing, paint for our homes, and even for our sisters' and mothers' hair pins, we must humbly bow our heads to scientific research.

Casein, which forms a little over three per cent. of the total weight of average cows' milk, has been prepared in various ways from milk for many, many years; but not until recently has it been prepared upon a large commercial scale, this being due to the many uses to which the product may be put. In the big casein factories they put a large amount of skim-milk, usually about 700 gallons, into a vat and heat it carefully to about 135° F., then very dilute sulphuric acid is added to precipitate the casein or curd. The whey is drawn off the coagulated milk and the curd is placed on the drain rack and cut into chunks, after which cold streams of water are played over the mass to wash out the acid and whey. The curd is then dried with rotary fans and after being ground in the

mill is ready for use. One hundred pounds of skim-milk will yield about $3\frac{1}{2}$ lbs. of dried casein. The casein companies will pay usually about $3\frac{1}{2}d.$ or $4d.$ a pound for this crude product.

Buttermilk is used to quite a large extent in the manufacture of casein. Makers of casein object to the buttermilk product, however, because it is coarse and dark, lacks the solubility possessed by the skim-milk casein, and does not make up into the high-class article that is possible with skim-milk.

If the manufacturer wants to make glue from casein he takes one part soft water, four parts casein, and one to four per cent. bicarbonate of soda. Casein glue can also be made by heating crude casein with about an equal volume of ammonia. Many of the patented formulas for casein glue are simply variations from the foregoing.

Milk casein finds an important use in the manufacture of paints. Everyone knows something about the adhesive power of milk. The addition of milk to whitewash increases the adhesiveness and durability of the wash. This principle is applied in paints. The casein makes a good drier and sticks well, giving good service because of its cheapness and long wearing qualities. These paints are sold under such trade names as "casein enamel paint," "casein cemented paint," "cold water paint," and others. Casein paints, when mixed with a little cement, make a splendid paint to apply on the trunks of trees to protect them from rabbits and other gnawing animals.

Casein finds a popular place in the studio, where it serves the same purpose as clay in modelling, while it is also made use of in the manufacture of photographic plates. Floor coverings, insulation material, imitation ebony and ivory buttons, combs, cigar holders, bells, rings, toys—all these articles are now being made from the casein of cow's milk. In textiles casein is utilised most largely in calico printing. It serves to "fix" the pigments so that an alkali will not dissolve them. In the paper industry casein has been used to convert the paper pulp into a moldable condition, as a glazing, and to fasten individual sheets together. The common food-stuffs, such as Plasmon, Nutrium, Lactarine,

Sanatogen and Galactogen, are made up mostly from casein, a feed rich in proteids.

We wear casein, we eat it, we use it for toys, trinkets, and everyday articles, and we finish up by shining our shoes with a polish that is made from the casein of cow's milk.—*The "Dairyman."*

REVIEWS.

A Note on the Milk-Supply of Bangalore. By A. K. Yegna Narayan Aiyer, M.A., N.D.D.

This bulletin on the milk-supply of Bangalore, again clearly demonstrates the urgent necessity of taking up the question of a better milk-supply to Indian cities.

With the increasing number of publications and pamphlets on this subject, we feel at last that this journal is not now alone "Crying in the Wilderness."

This journal was the first publication to bring prominently to notice that the Dairy Industry in India required to be put on a better and more sanitary basis, and we therefore welcome Mr. Aiyer's bulletin and recommend it to the perusal of our readers.

Of the many analysis made of milk retailed for sale (with the exception of that taken from cows milked at a local hospital) every one shows heavy adulteration with water.

The best sample shows 2·3% and the worst 1·2% fats.

Apart from the question of whether the water was clean or not, the selling price shows that these dishonest traders demanded a good price for a bad quality milk.

Mr. Aiyer proposes as a remedy, to ensure a purer milk-supply, to erect municipal milking sheds where the animals would be ordered to be taken, and milked under supervision, the cans being sealed by the supervisor.

How far these remedies would go to solve the problem remains to be seen, but we would recommend a study of the Committee's Report, of the methods proposed to ensure a better milk-supply to the cities in the

Bombay Presidency. This report was well received by the Agricultural Board at Pusa, and is worthy of being followed by other Provinces and States.

An adulteration act well carried out seems the best solution of the problem. When the proposals and new conditions under which milk is to be produced and sold in large cities like Calcutta and Bombay are in operation, we are of opinion that other municipalities will do well to study the procedure adopted and should procure much valuable data to work upon

We are glad to notice that very little milk was found to be imported from outside sources into the Civil and Military Station of Bangalore for retail as fresh milk.

Some four years ago large quantities of milk was brought into the station from Hebbal, Agram, and Bomanpalli districts and sold from dairies under very insanitary conditions. From samples analysed, adulteration was present in practically every sample taken.

The method of the transport of the milk left much to be desired. The vessels were found to be very dirty, and pieces of cloth, and wisps of Ragi straw inserted in the mouth of the utensils to prevent the milk spilling.

The Bulletin brings to light that the city milk is produced under insanitary conditions, and, from experience gained in visiting the places where the milk is produced, we are thoroughly in agreement with the remarks in this connection.

The housing of milch cattle in part of the building used for dwelling purposes is most undesirable, and the insanitary conditions of the byres render it impossible to obtain a pure milk-supply from such surroundings.

The suggestions by Mr. Yegna Narayan Aiyer for improvements as regards breeding a suitable type of animal for milk are sound, but we are doubtful if a dual purpose animal for milk and the male as a first class draught bullock can be produced.

***

THE POONA AGRICULTURAL COLLEGE MAGAZINE for the quarter ending March, 1916, has been received

and contains interesting articles on all dealing with matters of agricultural moment.

***

Dairying and Breeds of Dairy Cattle in India, by B. M. Ghare, Agricultural College, Cawnpore.

A very interesting book in Marathi. This is the second book published by this author, and contains many interesting additions to that published in 1913. We can confidently recommend this book to Indian students and others interested in scientific farming.

All correspondence regarding the Journal, advertisements, etc., should be sent to the Hon. Secretary, Dairy Education Association, No. 12, Victoria Road, Poona.

This Journal is issued Quarterly, in October, January, April, July.

RATES OF SUBSCRIPTION.

Annual subscription :—

Non-members, including postage	...	Rs. 4-0-0
Members of D. E. A. ...	...	Free
Single Copy, including postage	...	Re. 1-0-0

ADVERTISEMENTS.

			Annual.	One issue.
Full	page	...	Rs. 20-0-0	Rs. 6-0-0
Half	,,	...	,, 13-8-0	,, 4-0-0
Quarter	,,	...	,, 7-0-0	,, 2-0-0
6 Lines	...	...	,, 3-0-0	Re. 1-0-0

DAIRY EDUCATION ASSOCIATION.

191

THE HON. SECRETARY,

DAIRY EDUCATION ASSOCIATION

(INDIAN BRANCH),

POONA.

Dear Sir,

*I wish to become a member of the above Association, and if elected agree to promote the welfare of the Association to the best of my ability and to remain liable for my subscription until I shall notify the Hon. Secretary of my resignation. On receipt of your letter advising me of my enrolment as a member, I will forward the yearly * subscription of Rs. 3/12/- to the Hon. Secretary (Mr. G. H. Frost, Government Military Dairy Farms, Poona).*

Dairy School or Schools attended and length of time of instruction.

....

....

Dairying Certificate, Diplomas, etc.

....

....

(Signed)...

Mr., Mrs., or Miss, etc.

Permanent Address..

....

** The Year commences on 1st October.*

VOL. IV, PART I. QUARTERLY. OCTOBER, 1916.

THE JOURNAL OF DAIRYING

AND

DAIRY FARMING IN INDIA

DAIRY EDUCATION ASSOCIATION

D. E. A.

Printed by Thacker, Spink & Company, 6, Mangoe Lane, Calcutta, and
Published for the Committee, Dairy Education Association in India

CONTENTS

THE

JOURNAL OF DAIRYING

and

Dairy Farming in India.

VOL. IV.—PART 1.] QUARTERLY. [OCTOBER, 1916.

EDITORIAL.

THIS edition marks the beginning of our fourth volume.

The Sub-Committee have much pleasure in publishing in this issue of the Journal the Balance Sheet for the year.

The financial position is much more satisfactory, as will be seen from the Balance Sheet, and the future appears more hopeful.

The subscription, which has been enhanced to Rs. 5 per annum, will nearly cover the deficit.

We hope that our Members will endeavour to secure more subscribers to the Journal, and thus assist the Sub-Committee in their efforts to make the Journal a success, both from a financial and educational point of view.

The Committee has selected Mr. H. J. Riddick as a Member of the Indian Sub-Committee, and he has intimated his willingness to accept the invitation.

***

In this issue we have great pleasure in reviewing a most valuable work on fodder crops by Doctor Harold Mann, D.SC. (our worthy and energetic Chairman), which is the last word on "Fodder Crops in Western India."

***

We sincerely hope that other provinces will follow the lead of Western India and give us similar bulletins. How often one hears farmers saying that "they wish the Agricultural Department would give the public some of their elementary knowledge." It is not deeply scientific facts that are wanted at present—just an Indian "Complete Farmer" or a "Fream"; even something far simpler than these would suit better. We endorse these sentiments, and would be glad to see a good book on agricultural chemistry on the lines of "Warrington" in the Morton Series.

***

We hear that the Government military dairies are doing a vast business in connection with the war, and have fulfilled a most useful rôle.

About 10,000 lbs. of milk is supplied daily to hospitals for the wounded, and the Government Central Creamery at Ahmedabad is supplying on an average 15,000 lbs. of butter daily to the Forces overseas.

These institutions have justified their existence by helping to conquer disease in peace times, but they have doubly done so in war time.

Had these institutions not existed, it is impossible to see how these large hospitals could have been supplied, and in any case much suffering would have been caused by inferior supplies.

We therefore congratulate the department, and especially the energetic Head of the Southern Circle.

About a dozen applications from candidates for the N. D. D. (Indian) Examination have been received, but only seven are eligible. These will be examined from the 18th to 22nd December.

It is hoped that principals of agricultural colleges will conduct the examination for candidates in their respective provinces, thereby saving the long journey to Poona.

*
* *

The diploma has been designed, and is reproduced in this issue.

Mr. McA. Smiley, School of Arts, Lucknow, was the designer, and we are most grateful to him for his interest and labour. The production cost nearly Rs. 100, which amount has been most generously donated by a friend.

*
* *

Still another of our Members had suffered from German frightfulness.

The wife and daughter of Colonel F. W. Hallowes, Director of Farms, Army Headquarters, were on board the ill-fated P. and O. steamer *Arabia*, which was torpedoed in the Mediterranean.

They had a miraculous escape, and we are glad to hear they are safe and sound, and we desire to offer our congratulations to Colonel Hallowes on their safe arrival at Home.

Colonel Hallowes has been in Mesopotamia in connection with the fodder and dairy supplies to the Forces in that country.

*
* *

Members and Associates will kindly verify their addresses published in this issue. Any alteration necessary will kindly be intimated to the officiating Honorary Secretary, 85, Survey Road, Quetta.

It is proposed that each province and the Imperial Agricultural Department be represented on the Sub-Committee. It is therefore asked that some member may volunteer from the provinces, etc., which are not yet represented.

The following gentlemen have been elected Associate Members of the Association :—

A. C. Evans, Esq., C.E.,
Midlakes,
Sat Tal, Kumaon, U. P.

F. Jones, Esq.,
Deodars,
Bhim Tal, Kumaon, U. P.

E. G. Frost, Esq.,
Dentist,
Langdale,
Wesbourne Crescent, Southampton.

S. Frost, Esq.,
C/o S. Frost & Co., Ltd.,
Kennington Park Road,
London, S W.

DAIRY EDUCATION ASSOCIATION

INDIAN BRANCH

DIPLOMA

THIS is to certify that

Mr. J. V. Takle

has passed the Examination in the Science and Practice of Dairying and Dairy Farming in India.

Marks awarded in each Subject being as follows.

Practical Agriculture	56	Veterinary Science	60
General Dairying	84	Dairy Technology	90
Agricultural & Dairy Engineering	50	Dairy Refrigeration	70
Agricultural Chemistry	60	Chemistry & Bacteriology	64
Agricultural & Dairy Book-keeping	76	Practical Test	93

Total marks Possible 1000

Total marks Gained 703

Dated at Poona this 15th day of January 1916

Examining Board

(Sd) H. H. Mann
Principal Agricultural College Poona

(Sd) G. K. [illegible]
Professor Agricultural College Poona

(Sd) G. H. [illegible]
Offg: Asst: Director Govt. Dairy Farms Southern Circle

DISINFECTION OR HYGIENE ON THE DAIRY FARMS.

BY

G. H. FROST.

It is necessary first to ascertain what is generally *infected* and from what cause. This is a considerable undertaking when one considers the subject, and it would give matter sufficient to complete a voluminous book. We must therefore curtail it as far as possible to get it within the space at our disposal.

Infection is chiefly caused by—

(*i*)	Vermes (Worms) ...	Both internally and externally in all animals, crops, and soil.
(*ii*)	Bacteria and Protozoa	In the blood, organs, and tissues in animals, plants, and soils.
(*iii*)	Anthropoda Parasites	Mange, ticks, lice, etc., in animals, trees, and crops.
(*iv*)	Fungoids ...	As actinomycosis, pneumomycosis, ringworm, etc.

(*v*) The whole of the above may infect cattle sheds, fields, attendants, clothing, drains, grain and fodder, milk, water, etc

(*vi*) The above infection may be carried from place to place by mosquitoes, flies, men, dogs, pigeons, wind, fodder, grain, outside cattle, milk, water, etc.

From these six items we can begin to recognise what an important subject disinfection may be made, and that it must take into its scope very much more than is generally considered under this name

The importance of freedom from infection to the dairy farmer is too obvious to need pointing out, for should his cattle or produce become contaminated by, say, rinderpest and typhoid, he may be ruined and cause untold misery to his clientele.

The first thing therefore is to consider what the chief means are by which one may hope to prevent infection.

1. Cleanliness ! Cleanliness ! ! Cleanliness ! ! !

2 Careful isolation or segregation of all new animals in the herd for three weeks; also all sick animals.

3. Stocking of fodder received from outside sources sufficiently long to destroy organisms, or at least attenuate them.

4. Careful drainage of all grazing grounds and land where crops are grown, if in any degree water-logged. Grow all our own fodder if possible.

5. All stock should be immunised as early as possible from the most prevalent and dangerous diseases, *i.e.*, rinderpest, contagious abortion, and piroplasmosis.

6. Sufficient stock of preventive serum for immediate use should be maintained. A careful study is necessary of all diseases prevalent in the vicinity of the dairy, and those which may occur in our own herds. You are thus able to diagnose any outbreak of disease in its earliest stages, so that the preventive serum may be used before there are too many animals infected.

Serums should be stocked as follows :—

(*a*) For rinderpest : enough for whole herd.

(*b*) Hæmorrhagic septicæmia : for half of buffalo herd.

(*c*) Vaccine or blacklegoids for black quarter : for 25 per cent. of herd.

7. Good pure water for drinking purposes, dairy use, and for all employees is essential.

Drinking troughs should always be kept scrupulously clean and thoroughly whitewashed once or twice a week. It should on no account be used for any outside cattle, those in segregation, or sick animals.

8. All stock should be kept in good condition. Give sufficient salt for the animals to lick and some in the food. Feed judiciously. Wash buffaloes and grown cows daily.

9. Calves need special care; their navel cords should be antiseptically treated and tied with a silk thread at birth.

Each calf should receive its mother's milk or colostrum for the first week, as it possesses medicinal properties which cannot be imitated.

They should be judiciously and well fed and never be allowed to lose condition.

Isolate all calves with scours, ringworm, or mange. Provide wooden grids and some bedding for them to lie upon. Thoroughly whitewash their pens and mangers once or twice a week.

10. Keep a dairy farm free from dogs, goats, pigeons, and crows; also other stray animals.

The former infects drinking water and grazing grounds with echinococcus, the second carries disease; as do also pigeons and crows; the latter also pick the skin of calves.

Grain godowns, silos, and stack yards should be separated from the cattle yard or runs to prevent contractors' animals and farm stock coming in contact. Farm bullocks should be treated as outside animals, unless they are not allowed on outside roads, etc.

11. Wash down sheds, dairy, and all drains daily, and occasionally use disinfectants.

Corrosive sublimate is the most powerful disinfectant, and may be used in sheds and drains, provided there is no steel or iron as this drug will rapidly oxidise it. Quicklime is a good disinfectant when used fresh, and is excellent for dairies and milk rooms; also unslaked lime is an excellent deodoriser and helps to dry cold stores; it may be just half an inch thick on the floor and the grids laid over it Formalin is also a good disinfectant for the dairy. Wash up tanks, jharans, brushes, milk, trolleys, etc. Washing soda or wyandotte with hot water should be used freely for all cans, separators, bottles, filters, milk tanks, coolers, etc., and all should be steamed thoroughly in a steam chamber or sterilising room from half an hour to one hour. They should then be allowed to cool naturally and not be cooled by water.

12. Take every precaution to remove the fly pest from the cattle yard and all other parts of the farm, and on no account allow flies in the dairy.

This can be done by—

(*i*) Making fly traps with horse litter and burning these breeding beds every two days.

(*ii*) By keeping manure away from the farm premises or by spreading the same at once thinly on the land where the sun is strong. During

wet weather it should be thrown into pits and an inch or more of earth thrown over it each day.

(*iii*) Watch carefully for other breeding places such as, ash pits, brewer's grains, wet food, decaying vegetation, dirty drains, earthen or *kucha* drains, and any other moist or dirty places.

(*iv*) Saucers with half an inch of formalin and a thick slice of bread placed therein with some sugar sprinkled on the top will destroy flies in offices, dairies, milk rooms, etc. Work on the principles that each fly killed means many young ones less.

(*v*) Watch the surroundings of your own property to make sure that your neighbours are not breeding disease germs for your stock to be infected with.

Prevention of infection is the most important and the most worthy of our utmost efforts, and by dogged perseverance and undaunted determination it can be effected. It is often our neighbours who are hardest to deal with, and thus the necessity arises of having dairy farms well away from villages, towns, and other concerns generally.

The great Pasteur said : "It is within the power of man to make all infectious diseases disappear from the world."

Infective diseases from bacteria, protozoa, vermes, and the arthropoda may therefore be controlled to a great extent by extreme care. The fact that these parasites must have hosts upon which to live make it possible by intelligent hygienic measures to restrict their growth and even elimimate them, as has been done to a great extent in the British Isles. The authorities there have not of course the ignorance and prejudice to contend with that is met with in India.

Government dairy farms are succeeding to a great extent in keeping their herds free from diseases by the above methods. Even they are still far from perfect in carrying out precautionary measures.

The practice and thorough use of isolation and the discontinuance of moving cattle.—Animals should be kept in less crowded places, and should not be moved from place to place if it can be avoided. Now that it has been proved that chilled milk can be sent by rail satisfactorily, movements of animals are not now as necessary as in the past.

The training of managers to recognise the more general infectious diseases is most necessary, enabling them to act immediately on the appearance of disease.

Outbreaks are more easily overcome and greatly restricts their effects compared with former times.

To make the above methods really effective, the individual farmer or manager must have some definite knowledge of the principal diseases, since each one needs different treatment in regard to disinfection.

(To be continued.)

WEANING OF CALVES IN INDIA.

BY

H. W. VEALL.

In India the calf is allowed to suck its mother until a certain quantity of milk has been obtained for its own maintenance, and it is allowed to suck again after the milker has done, as compared with the European system of weaning calves shortly after birth and keeping them entirely separate.

About eight or nine years ago it was considered advisable to introduce the European system into India, and orders were issued by the Quartermaster-General to all Government military farms to carry it out. One farm was successful, but nearly all the others failed; and the effort was not persisted in owing to the great losses on the other farms. Gradually it was proved that it was principally due to the prejudice of the native *gowalas*, and want of determination on the part of the staff that the effort was not successful, and the experiment was again renewed with almost general success.

From the above it will be seen that the weaning of calves in India is not as easy to solve as one might imagine, and in undertaking the problem there are a number of points to be considered, the chief of which may be tabulated as follows:—

1. What we want.
2. How to attain it.
3. The advantages when attained.

(1) The material we have at our disposal cannot be considered the best. First of all we have to fight a strong natural affection which had been fostered for

numberless generations by the religious, commercial, and traditional system of the natives of India. Secondly, if we wish to rear the calves, we have to fight a naturally feeble constitution in most cases.

This strong natural affection is powerful enough to ruin the milk yield of the average Indian dam if her calf is taken from her. So it behoves us to ponder deeply over the method we are going to apply to bring about this separation. The calf is so liable to suffer by any food substituted for its natural supply that without great care it would probably die.

(2) The object of weaning is to separate the offspring from its dam without experiencing any adverse conditions affecting the value of either animal By way of argument there is much to be said for, and very little against, successful weaning.

The arguments for are of great importance to the owners, while the arguments against are few and can be easily remedied by care and careful supervision.

The advantages may be tabulated as follows :—

1. The calves are not present at milking time with their attendant hurry and bustle and general mess.

2. The milker's hands are not made filthy by handling the calf and its rope.

3. The calves can be housed some distance from the cattle shed, thus making far better ventilation and sanitation in both.

4. The calf can be fed with more regularity as regards quantity and quality.

5. The whole yield of the cow is ascertained and the richest milk is not left for the calf.

6. Only the best calves need be kept which may lead to a saving of many thousands of rupees per annum, as usually 50 per cent. of the calves are males and need not be kept one day.

7. The calves are often blamed for faulty milking ; this is prevented. There are no tales of calves getting loose during the night and sucking their dams.

8. When cattle are sent to hill dairies no calves need be sent, thus saving in freight and buildings for calves, etc.

9. Cows do not go dry when calves die, which was frequently the case with the old system.

10. Economy in establishment.

To accomplish the above, the manager must be determined to succeed. He must use tact to accomplish his ends. He must remove every obstacle which impedes his determination. He must train his men and cattle to overcome their prejudices to a custom inbred for centuries, and so obtain his milk without the objectionable sucking of calves.

(3) The method practised on one farm is as follows :—

The animals when purchased generally arrive at the farm with calves at heel, and the calf is permitted to suck at the first milking. This is done for two reasons : Firstly, to make the animals more comfortable in their new surroundings ; and secondly, to induce her to yield all the milk she may have held up owing to irregular milking, and the none too comfortable ride during the train journey. From this time forward the weaning commences in earnest. The calves are taken away to the calf pens, out of sight and hearing of their dams. At the next milking the dam is given a liberal tit-bit in the way of some concentrated food in order, if possible, to distract her mind from the calf, by the sucking of which she has been accustomed to drop her milk.

The milker then tries to induce her to drop her milk by gently rubbing one of her teats (usually the calf teat). If unsuccessful, the calf is brought and tied at the head of the dam but not permitted to suck. The presence of the calf usually consoles the mother and she drops her milk. This state of affairs continues until the animal becomes accustomed to her surroundings and her liberal food. It is then found that when the calf is taken away altogether she does not notice its absence and will drop her milk readily. The animal is now removed to a standing with the other animals that have been successfully treated and not permitted to come near animals with calves at milking time. Milkers, if not carefully watched, will allow the calves to suck in order to make things easier for themselves. This disobedience of orders is dealt with severely and they

are made to understand that strict compliance is most necessary.

At subsequent calvings the calf is weaned at birth and very little difficulty is experienced in getting the dam to milk freely.

With farm-bred stock there is no question, as they are not allowed a calf from the first calving Buffaloes usually give little or no trouble in this connection.

THE PERFECT METHOD OF CULTIVATION.

BY

MESSRS. WOODFORD AND GIBSON.

THIS article is confined to the actual working of the soil which takes place between the harvesting of one crop and that of the next. The general name given to these operations is "Tillage." Thorough tillage is the supreme principle of successful cultivation, and if it is neglected all care lavished on manuring, on irrigation, and providing of good seed is more or less wasted. The object of the farmer is to obtain as large an outturn from his land as is possible; hence any expense incurred which will increase the value of his outturn above the outlay is money well invested. From the point of view of the value of land, it is absolutely necessary that good tillage should be carried out, otherwise many valuable constituents of the soil which might be used are lost and many that can be made available remain dormant. The fact that States depend on agriculture to a great degree is generally accepted, hence we may say that the prosperity of a nation depends on the maximum development of its land. Arguing from this it becomes the duty of every farmer to use his land to the best advantage. And what can better please the heart of any man than to see a fine standing crop rise as the result of his labour, where before a stunted unhealthy growth, choked with weeds, repelled the eye. The theory of cultivation, now generally accepted, is the result of the scientific mind applied to this question; that is, first the hypothesis was formed and then came the proving tests.

Jethre Tull, the forefather of scientific tillage, in his book "The New Horse Hoeing Husbandry," published

in 1731, laid down the hypothesis. Though many of his ideas have been proved wrong, the theory of scientific tillage developed from that time and present day practice is the outcome of this. Some of the points which govern the practice of tillage follow :—

To prepare the soil so as to make the best possible home for the coming plant, so that it can put all its power into developing its growth to the maximum degree ; in badly prepared land much of the energy of the plant is wasted in fighting against the encroachments of weeds, penetrating hard soil to fix its roots and in searching for plant food. Good tillage breaks down the soil particles into smaller particles, thereby increasing the moisture holding power. It aërates the soil, increases the bacterial life, admits warmth in cold countries, and last but not least destroys weeds.

To do this are needed such implements as have been found by continued experience to be best suited to the purpose. It is interesting to trace the development of these. One can easily imagine the first cultivators scratching the soil with a pointed stone, and later on dragging a crooked stick over the surface. With the natural tendency of man to turn to his own use all things subject to him, the next step would be to fix a larger edition of the crooked stick to the horns of a draught animal. At this point and in subsequent development facts and not suppositions can be dealt with, until the present day plough with its cunning shape and contrivances has been evolved. However well and thoroughly a plough may be constructed, its work is limited, and the want of tools to further fine down the soil and make the required tilth has led to the introduction of the many and varied implements now at the disposal of the cultivator.

The practice of tillage following what has come to be known as the perfect method, runs on the following lines :—

A crop having been harvested, the disc harrow is at once used to break up the surface of the soil, thereby forming a soil mulch, breaking the surface tension, and consequently preventing evaporation of capillary moisture, while admitting all further supplies of moisture to the lower soil. This implement makes ploughing much

easier and the pulverisation done by the plough more complete. The question of manuring is now considered but is outside the scope of this article. Suffice it to say that it should be done just before ploughing; the next operation is ploughing, which should be carried out when the soil is in such condition that the breaking, turning, and pulverisation are carried out to the best advantage. This condition might be simply described as moist but yet crumbly. It is sometimes necessary to irrigate for this purpose. Then follows the cultivator, the implement preferred being a heavy type of harrow known as the spring tine harrow with regulating lever, and this helps in making the tilth aimed at. The next implement to be put on the soil is the ring roller which completes the breaking up of the smaller clods and compacts the soil, increasing capillary attraction from below and bringing up the sub-soil moisture into the tilth. As a prevention of evaporation, the peg-toothed harrow is put over the compacted soil forming a soil-mulch and completing the preparation of the seed-bed. The seed is now drilled in; an apparatus is usually attached to the drill to cover the seed. If it is not properly covered, the harrow should again be put over with tines reversed. After rain or irrigation, as soon as the surface soil becomes workable, the peg-toothed harrow with tines reversed should be run over again to prevent evaporation. If by any chance the land becomes weedy, and the crops allow sufficient space between the rows, the horse hoe should be used to eradicate the weeds, and at the same time to again form the partially destroyed mulch.

Comparison with Methods in use adapted to Actual Needs.

The modifications of the above method, which have to be resorted to, may in India be classed under three heads:—

(1) Monsoon conditions.
(2) Irrigation with inundation canals.
(3) Dry conditions.

1. In most cases it is too risky, where monsoon rain is relied on, specially on black cotton soil, to wait

for the first rain to get the best condition of the soil for ploughing. The rain may set in for good, consequently the plough cannot be put on the land at all for many weeks. Hence the farmer must be prepared before the arrival of the monsoon; that is, he must prepare his tilth as well as can be done under the circumstances without waiting for ideal conditions. The use of the disc harrow before ploughing is of great value when preparing a dry soil. Such moisture as would have been lost by evaporation is retained against the time of ploughing, and large clods will not be formed. The farmer must judge the time of arrival of the rains and have his seed-bed ready. He will, in all probability, not be able to inter-cultivate during the time monsoon conditions are prevailing, making the soil unworkable. It is therefore necessary to provide for this as much as possible before seeding. An example of this may be seen in the black cotton soil of the Poona District.

2. Where continuous irrigation water is available the ideal method laid down may be followed, with the exception that bunding and good levelling are necessary; the bunding is done immediately after seeding. The plots should be large enough to admit of the harrow being used later on. When inundation water is only available for a limited period, often only six or eight weeks, the procedure must be modified to suit the conditions, and frequently the same order of preparation for the water is necessary as dealt with in the remarks about the monsoon conditions. After the waterings, however, if possible, a mulch is formed by harrowing. The water-supply at the Government Dairy Farm land at Bagargi, near Ruk in Sind, is of this character; and hence the land is prepared so that it can be seeded a few days before the water rises to the level necessary for irrigation.

3. There can be no doubt regarding the enormous advantage gained by the method dealt with when applied to what is known as "Dry Farming." It may be said, in fact, that if this or a similar method be not followed, dry farming is a failure. This system is dependent on the gathering and preserving of any moisture given to the soil; and the principle of forming

such a mulch as best answers that purpose must govern all dry farming.

It has been shown that what is known as the perfect method cannot always be followed; but all experience has gone to prove that the nearer the farmer can get to this ideal, the better are his results. The attempt to reach it is more than worth while, and the soil answers to the care lavished on it. The following is the conclusion drawn by a well-known writer on this subject. Stir the soil thoughtfully and continually, and it gathers in the rains to make abundant growth of plants when summer's heat and drought are come; plough the land earnestly, and it gives its fat with gladness and with bounty; open the bosom of the soil with the plough share, and health comes to the land and wealth to the operator; spare cultivated fields the disgrace of ravaging weeds, and golden grain and bountiful harvests come as rewards; fine and mellow the earth, and luxuriant vegetation gladdens the heart and rests the eye; till and always till with skilful hand and eye, and Nature deeds her gifts: Success, Prosperity, and Joy.

TRANSPORT OF MILK BY MODERN METHODS

BY

"MAORI."

Now that the truth of the adage "The old order changing giveth place to new" is greatly accepted, even by those who reside in this old Eastern World, it behoves us to consider more fully the use of modern methods of transport and their relation to the dairy industry in India. The conditions under which milk was carried from place to place as recently as 1910 were very limited and left much to be desired. The adoption and successful practice of the methods now in vogue are due to the indomitable spirit and perseverance of the dairy pioneers, the introduction of refrigerating machinery, and the modern methods of pasteurisation.

The present methods of transporting milk by rail, though useful, are far from perfect, and until the railway companies concerned build and run refrigerator vans through the potential centres of the dairying industry, we cannot truthfully say the problem has been solved.

Despite the fact that the carriage of milk over a long distance presents formidable obstacles, milk has been, and is daily being transported hundreds of miles, reaching its destination in perfect condition.

Until two years ago a great deal of doubt existed in certain quarters as to whether this would be practicable, but since that time experiments have been made on a large scale, and the idea has been proved to be not only feasible but practicable. Had not the persons concerned, however, persevered in the face of all obstacles, a deplorable failure instead of a huge

success would have been the result. The determination and knowledge obtained from experiments overcame all difficulties.

During the past summer large quantities of milk were required for the wounded and sick from the Mesopotamian and other war fronts. The military dairy farms were called upon to supply this essential article of food to the various hospitals and convalescent depôts. In many cases the milk had to be railed long distances.

In some cases the distance was as great as 600 miles—a journey of 19 hours by rail. The milk arrived at its destination in perfect condition.

In all cases the milk was pasteurised and cooled at the despatching station, and again the operation was repeated at the destination.

The following list show some of the stations from which milk has been despatched and the mileage of each journey. There are many other examples in India on the same lines, those below being quoted as examples of what can be accomplished. The Jubbulpore-Bombay journey being first in the order of importance. The Ruk-Quetta is considered to be deserving of second place, though the distance and duration of the journey is not very great. Milk is sent to Quetta through the hottest part of India throughout the year.

The Bangalore-Wellington journey is also deserving of special mention, as not only it is a long one but the milk is transhipped on three occasions *en route*.

From	To	Miles.	Hours.
Jubbulpore ...	Bombay	619	19
Bangalore	Wellington ...	294	18
Mhow	Deolali .	284	12
Ruk	Quetta	224	14
Bangalore	Bellary	205	17
Kirkee	Bombay	119	4
Mhow	Khandwa	73	5
Anand	Bombay	285	10

As the foregoing journeys show the possibilities of the transport of milk by use of railways, it naturally follows that milk could be transferred from place to

place to meet fluctuations in local markets and to dispose of surpluses in dairies where the quantity of milk produced is in excess of local requirements.

It will be some time before the value of these experiments is thoroughly realised by the dairy industry in India, but when that comes to pass not only will the dairy industry be placed on a sound financial basis but it will help to solve to a great extent "The problem of a pure milk supply to Indian cities."

Farms can be located in healthy localities, away from the cities and their unhealthy surroundings.

The milk can be produced under sanitary conditions, pasteurized and cooled, and transported by rail to the large cities.

Not only from an economical point would this be an advantage, but there would also be a saving in other directions.

Fodder could be produced at these country dairies at much cheaper rates than procurable in cities, the dry animals more efficiently handled, and the milking herd receive the advantages of green fodder and ensilage.

Such advantages must act on the milk yield of the animal. Thus it will be seen that in every way there is a distinct advantage over the old methods.

A most necessary adjunct to the railway service for the rapid transportation of milk is the motor lorry. Until quite recently the value of these vehicles was not fully appreciated, and now that the prejudice against their employment has totally disappeared, the writer ventures to think they have come to stay.

Dairies are generally situated at some distance from a railway station, and as time is a great factor in milk distribution, an hour or so may be saved in the journey from the farm to the station, or *vice versâ*, thus enabling the milk to be despatched by an earlier train or to be carried quickly to the dairy for pasteurisation before issue, as the case may be.

The use of motor lorries would also be of great assistance in the transport of milk to hill stations where there is no railway service.

Such a system would be quick and reliable, enabling a central dairy on the plains near a hill station to

produce the milk under economical and efficient conditions.

Milk, to enable it to be sent on a long journey, by rail or by road, must be pure, placed in sterile cans, pasteurised to 180° F., and chilled to at least 40° F. Insulated cans should in preference to other types be used for the journey, and last but not least, a consignment must be handled quickly at both the despatching and receiving stations.

METHOD OF RUNNING AN AUXILIARY CREAMERY.

BY

MESSRS. STOVOLD AND VAUGHAN.

General.—In the first instance it is essential that a manager should have an intimate knowledge of the surrounding district and be thoroughly conversant with the prevailing rates of milk. This, combined with a knowledge of the character of the native supplier and tact in dealing with him, is necessary to obtain the best results. Possibly too much stress cannot be laid on the latter. No cash advances are to be made on any account to these people.

A drip test of a composite sample of all milk supplied should be taken every day. This keeps a check on the weekly tests. Great accuracy is necessary to give the supplier full value without causing loss to the creamery.

Lighting and Ventilation.—An electric installation is the most suitable, cleanest, and economical in the long run. A good system of ventilation is an important factor. The dairy should be light and airy with fly-proof gauze on all doors and windows.

Disposal of Sewage.—This is always a difficult problem, but may be overcome with a few acres of land and continual ploughing. The sewage can be run on to the land by open drains, which can be easily cleaned by a solution of phenyle and a good brushing.

Suitable Buildings.—Too large and capacious a building is not wanted. Good judgment in the matter of planning out the position of the machinery will enable this to be erected as compact as possible, with no more shafting than is necessary. Care must be taken,

however, not to overcrowd the creamery. This point needs careful consideration in order to provide a good working floor space in the centre of the room and about the machines for cleaning purposes.

The following dimensions have been found to be suitable for a branch creamery taking in 30,000 lbs. milk daily :—

50 feet × 34 feet, with a raised platform for receiving the milk, 16 feet × 12 feet × 3 feet high ; the idea of the platform being to gravitate the milk into the pasteurizer.

Routine.—The milk is taken in twice daily, morning and evening. Preparatory to starting, all machines should be examined to see that they are well oiled and in good running order. The separators should be running to speed and all the cans thoroughly cleaned with hot soda water, steamed and then air cooled.

The milk as received from suppliers is tipped into the weighing machine, from whence it runs through a filter into the milk tank and down by gravitation into the pasteurizer, and thence to the separator. If a contract for the separated milk has been made with a Casein Manufacturing Company, the milk is only heated in the pasteurizer to a temperature of 110° to 120° F. and then separated, the cream afterwards being pasteurized and cooled. It is then run into cans, weighed, sealed, and sent to the creamery. After this all pipes should be disconnected and steamed ; tanks, weighing machines, etc., washed with hot soda water ; all brass work should be polished, floor washed and scrubbed with scalding water, and lime used as a disinfectant. Cans not in use to be placed out in the sun. Everything in the dairy to be left clean, neat, and tidy ; parts of the separators to be left on the racks, not on the floor. Further, the native staff should be given clean clothes to wear during working hours. Lubricating and other oil to be weighed out daily, and the keys of the stores always retained by the manager.

When milk is sent by rail transit to any other dairy, special precautions have to be taken to enable the milk to arrive sweet. Strict attention must be made to ensure cans being sterile. At the time of despatching select the freshest milk, pasteurize at 185° F. ; the first flow of milk that enters the pasteurizer should be

emptied and poured back again into the tank : thus the whole of the milk is heated to the required temperature. The next point is to clean the milk. This can be done to a great extent by running the hot pasteurized milk through the separator, which has both the separated milk and the cream outlet running into the milk pump. It is then cooled down to 40° F. and run into cans through muslin; the cans are now sealed, having previously been insulated with straw and sacking, which is damped with cold water just before despatch.

The Manager must keep a keen eye on the wearing parts of the machinery and thus be able to foresee any possible breakdown; also to have actually in stock those wearing spare parts that are essential.

Accounts.—The amount of milk should be entered daily against each supplier's name in a Rough Inward Day Book. The results of the milk tests should, when ever taken, be entered into the Test Book by the Manager and the bills prepared on the following day. In the event of there being a large number of suppliers, he should make it his business to know each one personally and thus avoid any possible confusion whilst paying out Should any supplier be illiterate, the left thumb impression must be taken and initialled by the Manager. The amount of the weekly payments are to be entered into the Cash Book, Rough Inward Day Book, and Bought Ledger; bills to be posted in the Guard Book and given a Folio number.

Equipment for an Auxiliary Creamery taking in 30,000 lbs. milk or more daily.

Serial No.	No.	Names of Articles.
1	1	Oil Engine, 25 B. H. P., at Sea Level, 4-Cycle.
2	1	Steam Engine, Horizontal. 21 B. H. P.
3	1	Steam Boiler, Cornish Type, 30 H. P.
4	1	Steam Boiler, Vertical Type, 10 H. P.
5	1	Dynamo, 110 Volts 4 Kilowatts.
6	1	Electric Motor, 4 B H. P., for Well Pump.
7	1	Refrigerating Machine, Hall & Sons CO2 No. 6.
8	1	Heenans & Froudes Water Cooler, No M 6.
9	1	Pump for Well (kite pattern).
10	1	Worthington Feed Pump, 3" × 2" × 3".

Equipment for an Auxilary Creamery taking in 30,000 lbs. milk or more daily—concld.

Serial No.	No.	NAMES OF ARTICLES.
11	1	Centrifugal Pump for Sewage Water.
12	1	Platform Scale to weigh 5 cwt.
13	...	Necessary lengths of 2½" shafting with plummer blocks, pulleys, etc.
14	2	Oil Filters (Wells).
15	1	Motor Lorry, 1½ tons.
16	1	Pasteurizer, Astra Type E, No. 4.
17	2	A. V. Separators with spare parts.
18	2	Milk Pumps Armagh with 1½" and 1" suction and delivery, respectively.
19	1	Beam Milk Scale (Stathmos).
20	1	Conical Milk Cooler with pipes, valve, etc.
21	1	Icy cold compound milk cooler to cool 250 gallons.
22	2	Steaming blocks with piping valve, etc.
23	1	Galvanized iron wash up tank with pipes and valves.
24	1	Water Tank, 10′ × 6′ × 4′.
25	1	Brine Storage Tank, 8′ × 6′ × 4′.
26	1	Butyrometer Steam Turbine (to hold 32 Tubes) with table.
27	2	Measuring Drums 30 gallons.
28	2	Hygeia Milk Filters.
29	80	Firsteel Milk Rail Churns 12 gallons.
30	2	Water Heaters.
31	1	Table, 6′ × 4′.
32	72	Test Tubes for Gerber Butyrometer.
33	2	Automatic Measure for Acid 10 c.c.
34	1	Automatic Measure for Alcohol, 1 c.c.
35	6	Pipettes for Milk, 11 c.c.
36	72	Sample Test Bottles 8 oz.
37	12	Can Brushes.
38	12	Hand Scrubbing Brushes.
39	12	General Purpose Brushes.
40	5,000	Tin Seals.
41	1	Office Safe.
42	...	Necessary office furniture.
43	...	Complete spare parts for all Engine, Refrigerating, and Dair Machinery.
44	...	Necessary lengths of Balata and Leather belting.
45	1	Rack for spare parts.
46	1	Sign Board.
47	1	Pair Seal Pincers for Tin Seals.
48	1	Milk Receiving Tank 250 gallons.

WHY PASTEURIZE DAIRY PRODUCTS?

BY

H. H. DEAN.

Mankind is continually assailed by unseen foes in the form of minute plants called bacteria, commonly known as germs. These gain access to the human body through openings of the skin, such as a scratch, a cut, or a bruise. These apparently trifling things should not be neglected, as the human skin is like a silken shield against foes invisible. "Blood poisoning," "lock-jaw," and similar causes of human destruction are frequently the result of not paying attention to a minor injury, and the weak system is unable to resist the attack of "germs." The strong person is able to overcome these attacks; hence thousands of scratches, cuts, etc., do little or no harm, but it is always safer to disinfect by some means—tobacco juice, if nothing else is available, as tobacco is a slow poison and germ killer.

The second means by which bacteria gain entrance to the system is by means of the food and drink. For instance, medical authorities tell us that typhoid infection can come about only through the mouth—if what we eat and drink be clean and free from typhoid germs we cannot "take" the disease. It is probable that other contagious diseases like tuberculosis, or what is commonly called "consumption," are spread by the food which people eat. The "breathing" theory of spreading disease is gradually being discarded. The probabilities are that the mouth is the great source of infection for contagious diseases.

While milk is undoubtedly the most valuable food for humans, especially in the early stages of our career, it is unfortunately also a good place for disease germs

to grow and multiply. Hence the chief reason for the pasteurization of dairy products intended for human consumption lies in the fact that this is an easy and effective method of killing germs causing various ailments among humanity. Fortunately practically all these organisms causing sickness among the members of the human race are killed at a comparatively low temperature from 140° to 160° F. While some recent investigations would indicate that probably electricity may be used for sterilising milk in the near future, thus doing away with the need of heating, we may be able to electrocute bacteria in milk effectively, without the so-called injury to its food properties, caused by heat. Up to the present we know of no such effective agent for purifying as heat. A strange thing about heat or fire is that man appears to be the only animal that understands fire—who can renew it if it goes out, who can control it. and make it serve his uses. No doubt the man who first discovered fire was persecuted, probably consumed by the agent which he had produced, but fire heat is the greatest aid to man in making pure his foods.

The second advantage of dairy pasteurization is that it makes a clean seed-bed for pure cultures or pure seed of the desired type. This is specially advantageous in butter-making, and in making sour milk drinks, such as the much advertised Bacillus Bulgaricus, which, if taken often enough and in large enough quantities, might enable a person to live forever, if one would believe all the articles which have been written concerning this rejuvenator of the human species.

A third advantage is that milk and cream properly pasteurized will keep sweet much longer than if not so treated. We have kept samples of pasteurized milk sweet at ordinary room temperature in summer for five or six days, whereas similar milk unpasteurized would sour in 12 to 24 hours. Nothing makes the housewife so cross and out of temper as to find the milk and cream sour. Probably some is needed for baby, or a sick person, and on going to the pantry, cellar or refrigerator, for the needed supply, it is found to be sour. In all probability when the milkman next appears at that house he will hear something not at all

pleasant about his milk being sour. The remedy is pasteurization. In winter time it is almost impossible to prevent more or less feed and stable flavours in milk. The air of the stable contains these odours, and as the stream of milk passes from teat to pail, it carries with it the flavour-laden air. (This danger is eliminated with the milking machine, and is one of its advantages.) Most of the feed flavours are due to volatile oils, which are driven off in the process of heating. Anyone who has stood near a pasteurizer while operating in winter cannot help but notice these flavours coming from milk and cream. In most cases it will pay to pasteurize in winter, in order to prevent undesirable flavours in the milk and cream, thus pleasing customers, which means increased trade.

The butter-maker should pasteurize milk or cream in order not only to improve the flavour of his butter, but chiefly to improve the keeping quality of butter exported. A considerable quantity of summer butter is stored for winter trade, and the merchants are usually willing to pay at least half a cent. a pound more for pasteurized goods as compared with unpasteurized, because they know from practical experience that they can depend on the quality of butter made in creameries where pasteurization is properly carried out.

Pasteurization is the chief factor in Danish butter, as this results in uniform quality, which gives confidence to the British buyer and consumer. It will do as much for butter-makers if properly carried out and consistently and persistently followed.

REVIEWS.

Fodder Crops in Western India, Bulletin No. 77 of 1916. Dr. H. Mann, D.SC. (Principal, Agricultural College, Poona), and Chairman, Dairy Education Society, India. Price 11 annas 3 pies.

We have much pleasure in acknowledging the receipt of this bulletin. Dr. Mann is well known to all those having any connection with agricultural or dairying work in India. Apart from his work as Principal of the Poona Agricultural College, there is no man in India to-day who has laboured more earnestly and with more determination in the cause of Agriculture, and to bring about a better and purer milk supply to "The cities of India."

His writings on dairying and other agricultural matters are well known to our readers, and we welcome another effort from Dr. Mann's able pen.

The book now published is one of immense value to all interested persons, and will be of great value to students and others.

In the case of students it has in the past been a most tedious and laborious task to wade through many books to gather the required information regarding the fodder crops of this country. Not only was the task a tedious one but it was extremely difficult to reconcile the difference in figures between the various authorities.

Here we have a book containing a mass of information, condensed in such a manner that the student can assimilate exactly what he requires and does not need to wade through matters of little importance.

The book is one that will be the standard work in connection with the fodder crops grown in Western India, the study of which we earnestly recommend.

It will doubtless save the intending agriculturist many failures and disappointments.

To those who have passed beyond the beginners' stage, the book will provide information and data, and will add to their knowledge, which, if carried out, will add to the outturn from their lands.

It is also a very important point to be considered that, apart from the growing of crops for seed, there is an increasing demand for fodder to supply the requirements of the larger centres.

Perhaps more important is the fact that the natives of India are beginning to recognize that if they require animals to work, or in the case of cows to provide milk, it is essential and profitable to produce good fodder crops in order to obtain the best results.

BY THE WAY.

Over-run in Butter-Making.

How to gauge it.

The over-run in butter-making is often confusing to those not familiar with the composition of butter, nor with the process of making it.

Over-run means merely that one pound of butter-fat when churned into butter will produce more than a pound of butter, just the same as a pound of flour when mixed with yeast, milk, salt, and water will make more than a pound of bread—or over-run.

When the cream tests 25 per cent., it requires four pounds of such cream to contain one pound of butter-fat. After the removal of the butter-fat by churning it is washed to remove the butter-milk, then salted to suit the market. The composition of average butter is as follows :—

	Per cent.
Butter-fat	82·5
Water	14
Casein ...	1
Mineral matter	2·5

In the process of making butter, the constituents naturally would vary the same as bread, depending upon the skill of the maker. In both cases, the water would vary the most, so is responsible for the greatest variation in over-run. Yet it would be impossibie to make either bread or butter containing no water. In fact, all food products, whether of vegetable or animal origin, contain more or less moisture, and this element is one of the things that make our food wholesome. Again, the mineral matter in the butter, which is salt, largely varies from none at all to four per cent., according to market demands. The amount of casein left in the butter has the least effect upon over-run, for

it occurs in small amount, depending upon how well the butter-milk is removed from the butter.

To calculate the percentage of over-run: Suppose we take 70 pounds of butter from 200 pounds of cream containing 60 pounds of butter-fat. Apply the figures to the formula.

Weight of butter, minus weight of butter-fat multiplied by 100, divided by the weight of butter-fat, is equal to 16 2-3 per cent.

In other words, dividing the increase (10 pounds) by the original amount of butter-fat (60 pounds), and multiplying by 100 gives the percentage of over-run.—*C. Q. M R.*

***

Retaining Afterbirth.

The trouble caused by cows not cleaning properly is very considerable, and the dairyman does not take the precaution he should. A cow calving after a dry spell will certainly have greater trouble in discharging this dead and poisonous matter from her system than one that has been grazed on fresh pastures during a wet period. In any case, each cow that is expected to give her best return to the dairyman should be treated as soon as calved. For practical use it is impossible to state from any outside appearances whether a cow has cleaned or not, and internal inspection would not be absolute proof, as particles could remain undetected. The treatment assists nature and helps to prevent contagious abortion and milk fever, and for the sake of returns and humane treatment, the farmer should follow this method, not on part of his cattle, but on the whole herd.

Treatment.—Early after calving, wash your cow with a warm solution of water (90 degrees) and Jeye's Fluid, Lysol, or Condy's Fluid and drench the cow with Skinner's Mammitein Drench. Only a good flow of pure blood will purify and stimulate it into giving the greatest results.—*C Q. M. R.*

***

Misuse of Milk in War Time.

The conditions brought about by the war have made it necessary to consider what things are necessary for

the welfare of the people in the way of food and what are superfluous. In other words, are raw materials being employed to the best advantage in view of the present state of affairs? Take milk, for instance. It is a well-known fact that, apart from the consumption of raw milk, a very large quantity is used in making chocolates and sweets, and this at a time when a tremendous supply of butter and cheese is required to feed the army, the navy, and the civilian population at home. It may be assumed that the man in the street would be able to buy his butter and cheese cheaper if the surplus milk now used for making sweets was utilised for the production of the above commodities. There is no need to ask which is the most essential to the welfare of the people, and it must also be remembered that in making cheese and butter there are valuable by-products which play an important part in producing meat. It is obvious, of course, that the diversion of surplus milk into regulated channels could not be done without some people suffering inconvenience and loss, but it would only be adding to the number of those who are adversely affected by prevailing conditions; and, after all, we have to remember that we are at war. The things to do in these days are obviously those which are the best for the community as a whole, and the time appears to have come when a decision should be made as to what should be done with the milk that is not required for consumption as such.—*Mark Lane Express.*

* * *

Fertilisers.

The World's Production

An impression of the enormous quantities of artificial fertilisers employed in the world before the outbreak of war is shown in figures published in England. The figures cannot be more than approximate, but they serve to show how dependent agriculture has become upon the fertiliser industry.

1. *Phosphate of Lime.*—The total production is estimated at about 10,000,000 tons, of which 8,000,000 may be attributed to super-phosphate, and 2,000,000 to

basic slag. This does not include the large quantities contained in guano, bones, etc.

2. *Potash Salts.*—The Stassfurt mines delivered potash salts in different forms equal to about 500,000 tons of pure potash.

3. *Nitrate of Soda.*—The shipments of this commodity from Chili amount to about 2,000,000 tons a year, of which it is roughly estimated that three-fourths are for agricultural and one-fourth for chemical industries.

4. *Sulphate of Ammonia.*—The total production approaches 1,000,000 tons a year, which is employed for agricultural purposes.—*The Dairyman.*

*
* *

Dairy Items.

The three things to consider in purchasing a dairy bull are individuality, breeding, and the milk records in the pedigree.

Milk should be removed from cowsheds to the dairy as soon as possible after milking, and either separated or set up in shallow pans.

Suitable attire for milking would be aprons or overalls of some washable material—for either sex—hessian or dark blue drill or cotton material.

Cows must be kept clean and healthy and have pure air to breathe, and then they will return a volume of rich, nutritious milk in paying quantities.

The dairy cow should be bred for generating in milking lines; she should have a typical dairy type and a strong vigorous constitution and dairy capacity.

Study the question of feeding: it is an art based on science, and worth a lot to every dairyman. Don't think that it will not pay to give the cows a variety of feeds.

Have the same person milk the same cows as far as possible; a change of milkers almost invariably makes a cow nervous, which affects unfavourably the milk flow.

Do not forget to put a few oats in the calf's feed-box. Calves will eat whole oats about as soon as anything, and perhaps nothing is better for them, especially when the milk supply is short.

It is not the best to let milk stand in pails any length of time before separating it. Take it out at once and put it through the separator. Cream begins to rise right off.

***

METHODS OF MAKING BACTERIAL COUNT.

THE method of determining the number of bacteria in milk is most commonly done by making what are known as plate cultures.

The nutrient solution used by the bacteriologist is quite similar in its composition to ordinary beef broth. This material can be rendered a solid at ordinary temperatures by adding to it 10 per cent. of gelatin. As is well known, this mixture of beef broth and gelatin will melt when its temperature is raised to blood heat or even somewhat below. A definite quantity of the milk, which is to be examined, can be mixed with the gelatin while it is in the melted condition. The mixture can then be poured into shallow glass dishes and placed at such temperatures as to cause the gelatin to become solid. This will take place very quickly and the bacteria that were present in the milk will be distributed throughout the solid gelatin. The bacteria will grow, however, and the mass of growth resulting from the development of a single organism will be large enough so that it can be seen by the naked eye. These masses of bacterial growth are termed "colonies." By counting the number of such colonies which have developed, one can determine the number of bacteria that were present in the quantity of milk which was added to the culture plate.

It is, of course, evident that everything which is used in the making of these cultures, except the milk, must be perfectly free from living bacteria. In other words, the gelatin must have been sterilized and all the glassware used in the preparation of the cultures must likewise have been sterilized. When this condition has been satisfied, the bacterial colonies can have resulted only from the growth of the bacteria that were present in the milk. In its broad outlines this method of determining the number of bacteria in milk

or any other substance is a very simple one. It demands, however, a considerable amount of training and experience before the results obtained can be considered trustworthy. The time and expense required for the preparation of the various materials and the carrying out of the work are such that it is questionable whether it is advisable for anyone who has not had laboratory training to attempt the work.

Other methods are used for determining the number of bacteria in milk. The one which is best adapted to the farm or to the milk depôt is the so-called "reduction test." It has been determined that when a definite amount of the dye, methylene blue, is added to milk and the mixture is placed at a temperature of the animal body, the blue colour disappears at a rate which is determined by the number of bacteria present. Milks which contain several million bacteria per cubic centimeter will become colourless in a few moments. Milks which contain but a few thousand bacteria per cubic centimeter will not become free from the blue colour for several hours. This method requires but a small amount of apparatus, and the precautions that are necessary in making the test could be learned by anyone in a comparatively short period of time. This process is a rough one as compared with the plate culture method. For example, it would be impossible by the reduction method to determine whether a particular sample of milk contained 5,000 bacteria per cubic centimeter, or 10,000, or even 20,000. It, however, will divide milks into several great classes, depending upon the bacterial content. In many cases this is all the information that is needed and it would seem that the reduction test might be used in many places.—*Hoard's Dairyman.*

***

Cows holding up Milk.

It is quite common to find cows that have the bad habit of holding up their milk—a thing that is hard to overcome unless a person knows just how to go about it. There is always a definite reason for it, however, as a cow that has everything to please her physically and

mentally will be very unlikely to hold up her milk, and a cow that holds up her milk and is put in physical and mental comfort will quite probably give it down again. *Farm and Home* (England) discusses this subject briefly in a way that gives some interesting pointers to persons dairying anywhere, and says:—"Cows are often 'difficult' in regard to giving down their milk perfectly in the height of the milking season They fall into the habit in the flush of feed from tenderness of the udder, especially if the spaces between milkings are unequal, so that at one of them the bag becomes very much overstrained and painful. The bag thus becomes inflamed, swollen, and hard, and withholding the milk or any part of it tends to increase the difficulty. From an unequal division of time between milking, some cows habitually hold up their milk at night and give it down in the morning. The habit once being formed there is no sure cure for it. The same treatment will not work alike on different cows. As a rule, cows give down best in a few minutes after they first come into the stable or yard without having any food before them or anything to attract attention or disturb them, but some will give their milk more freely if eating something that they relish well, so that their attention is more taken up with the food than the milking. Regular, evenly timed, quick, quiet, and comfortable milking is essential, and the best means both for preventing and for breaking up the bad habit in cows of holding up their milk."

***

Casein in Demand.

Among the many articles of commerce that have become scarce on account of the European war is casein made from milk. This product, which is now produced to some extent in the United States, is handled largely in Germany, which produces much raw casein, but also imports under normal conditions large quantities from Russia, South America, and other parts of the world, and manufactures it into a number of products, but mainly converting it into a sizing for paper making. American paper manufacturers have,

therefore, in the east depended upon Germany for their supply of casein, but with this source cut off the American product falls so far short of the demand that paper manufacturers claim: the price, too, had advanced from one hundred to two hundred per cent.

In consequence of the shortage of casein it is reported that American dealers are making extraordinary efforts to induce creameries to produce it, and are offering attractive prices for it. In the days when most of the milk was separated at creameries, casein was a fairly profitable way of disposing of skim-milk, but the farm separator having displaced this system, few creameries have skim-milk to dispose of at the present time. Under the new conditions, however, it is not improbable that creameries may find it profitable to invite their patrons to deliver milk so as to give them a supply of skim-milk for casein making.—*The Dairyman.*

*
* *

Butter-Fat and Feeding.

At the last meeting of the Sale of Food and Drugs Committee of the Aberdeen County Council, Dr. Tocher, analyst for the county, said that the proportion of butter-fat in milk could not be altered by feeding. Volume could be increased, but the proportion of butter-fat depended on qualities inherent in the cow. He suggested the advisability of having included in future legislation a system of grading milk according to the proportion of fat. Milk containing 3 to 3·5 per cent. of fat should be sold as one grade; that containing from 3·5 to 4 per cent. as another grade, and so on. The Chairman: It is not a difficult matter. Mr. J. Innes: The feeding has much to do with the quality of the milk. Dr. Tocher said they knew from large experiments, affecting hundreds of cows, that that was not the case. It was admitted that if wet food were got back, and rather more cake given, the butter-fat might be increased temporarily to the extent of perhaps a quarter of one per cent., but it was a well-known fact that feeding did not alter the proportion of butter-fat in ordinary cases. Its only effect was to increase the yield.—*The Dairyman.*

Quick and Slow Milking.

In the course of a paper by Dr. C. Crowther, read before the British Association, data were adduced in support of the view that, in addition to removing milk previously formed, the handling of the teats may impart a stimulus to further vigorous secretion during the period of milking.

The milk from the "quarter" of the udder milked first had a tendency to steadily increasing fat content as the quarter was emptied—a tendency which was much less pronounced with the subsequent "quarters" milked, although in the case of all four quarters there was a rapid rise in the percentage of fat towards the close of milking. When the quarters were milked in pairs the results from the first pair resembled those from the first quarter, and those from the second pair those from the last quarter; when the four quarters were milked simultaneously the results from each resembled those from a "first quarter." The milk from the quarter milked first was almost invariably the richest in fat, and that from the last quarter the poorest. The foregoing observations led to the conclusion that the time-factor must be of considerable importance in milking. This was confirmed by a comparison of very quick and very slow milking by ordinary methods, which showed a difference of 10 per cent. of milk-yield and 40 per cent. of fat-yield in favour of the quick milking.

A further comparison was made of ordinary milking, taking the teats in pairs, and simultaneous milking by two milkers, of all four quarters. A difference of 2 per cent. in milk-yield and 6 per cent. in fat-yield in favour of the latter method was indicated, despite the occasional disturbance of the cow inevitable with this mode of milking. Further tests with the milking machine are proposed.—*M. E. M. Q.*

***

Ropy Milk.

Stringy or ropy milk is due to the action of bacteria which find their way into the milk from various

sources and are often difficult to eradicate. It is sometimes found that the drinking tank or the tanks where the milk and cream are cooled contain the bacteria which are the source of the trouble. Herds permitted to wade through low places often produce ropy milk. The germ is sometimes carried into the milk through improper sterilization of the milking utensils. When it comes in this way, it is comparatively easy to get rid of, as all of the milk pails, strainers, strainer cloths, and milk cans, in fact everything used in the handling of milk, can be placed in boiling water for a period of ten to fifteen minutes, and this will destroy the germs or bacteria; or, if there is provision for sterilizing with steam, this will also be very efficient.

If the trouble happens to come from other sources than the utensils, such as low and undrained pastures about, the only way to get rid of the trouble is to keep the cows from the low places and thoroughly wash the udders and flanks with some disinfectant like a solution of choride of lime or Bacili-Kil. If there is reason to believe that trouble arises in the tank from which the cattle drink or where the milk is cooled, then these places must be thoroughly cleansed and sterilized.

From the statements made in the inquiry, we would place first suspicion on the milk cans or the cooling tank in which they are set. It would be wise, in any event, to sterilize all the dairy utensils, and if the trouble does not then cease, start with the cooling tank, and then proceed down the list to discover where the bacteria may enter the milk.—*Hoard's Dairyman.*

***

Milk Contamination.

An interesting case of milk contamination was brought to light at one of the dairy science schools held by the N. S. W. Agricultural Department. A dairy-farmer supplying the factory had carried out the instructions of the Inspector regarding the cleanliness of his milking-yards, dairy, etc., but when the cream from his firm reached the factory it had a very pronounced odour. Investigation disclosed the fact that

some of the cows in this herd had aborted or slipped their calves. Owing to the cows not being cleaned internally, the germs from the decomposing matter after the abortion found their way into the milk, bringing about a decomposition of the albuminous products therein and setting up a very foul odour.

When the supplier was notified of the cause of the mischief, he at once isolated the affected animals. The cream supply from this firm immediately became of high quality, resulting in superfine butter.—*C. Q. M. R.*

***

What is Casein?

Professor H. H. Dean, in answer to the question, "What is Casein?" says in the *Farm and Dairy*:—

"It is the chief nitrogenous compound found in milk, and consists, chemically, of the elements carbon, hydrogen, oxygen, and nitrogen. It is distinguished from milk fat, in that it contains the element nitrogen, the most valuable of all elements for plant, animal, or human food. It is the most expensive fertiliser which the farmer needs to purchase. It is the most expensive ingredient which the housekeeper buys in food. The white of an egg, the lean portion of meat, the curd of cheese are common examples of foods containing the element nitrogen. It alone builds muscle in the animal or human body. Plants deprived of nitrogen wither and die.

Casein is secreted in milk by the cow by means of special cell activity. Its primary source is the nitrogenous material in the food fed to a cow, which is transformed into blood, and from the blood it passes into the milk through the action of cells. The foods fed to a cow containing nitrogen are the most expensive to purchase, such as clover, hay, peas, and gluten meal, bran, oil-cake and cottonseed meal. Without a fair proportion of foods fairly rich in nitrogenous matter, it is impossible for the cow to produce milk economically. And yet in testing milk at cheese factories some would utterly neglect this important ingredient of milk and cheese.

The Age to breed a Heifer.

Different Breeds, Different Season.

An important factor in the management of a dairy herd is the time at which the heifers should be allowed access to the bull. "There is a good deal of difference, even among expereinced breeders on this point (writes Mr. M. A. O'Callaghan in his dairy book), but this difference I account for, mainly, by the fact that breeders with different opinions have gained their knowledge from observations of a single breed, and, therefore, it is only natural to expect that they differ from others who have their experiences from the breeding of animals of an entirely different race.

The Ayrshire and the Jersey, for instance, have to be dealt with differently from this point of view, as it is well-known that Jerseys will come into use at a much earlier stage than will Ayrshires and Shorthorns. This holds good as regards males as well as females, and these peculiarities must be studied by the successful breeder of this race of cattle. As a general rule, however, the dairy farmer is dealing with cross-bred females, and it is found that about eighteen months is, generally speaking, a suitable age at which to allow them access to the bull.

A backward heifer, however, should be allowed to become more mature; while if a heifer shows an inclination to lay on flesh and reach maturity at an early age, she may be put to the bull even younger, for, needless to say, the tendency to yield milk is not developed, as a general rule, until the period of motherhood approaches.

This raises the question so frequently discussed—namely, the risk of stunting young dairy cows by allowing them to get in calf too young, but it should be borne in mind that it is better for the dairy farmer to have a slightly stunted cow and a good milker than to have a well-grown animal and an inferior milker.—*The Dairyman.*

***

Things to Remember.

The cow is a creature of habits, and if you have formed the habit of having her eat a dainty while being

milked, there will be trouble if you fail to bring the tribute. She may kick more really than literally.

Do not commence too early to figure the cost of the calf's daily feed of milk. You may get cheaper grains on cheaper feed, but you will have a cheap, runty calf on which subsequent feeding will not tell as it should.

Milk out the last drop. The least "strippings" (milk left in the udder) are a sure indication of the skill in the work, and these contain the greatest amount of butter-fat—hence the "strippings" are the richest milk of all.

"Sourness in the soil caused by want of drainage or the application of manures which use up the lime in the soil is responsible for most of the unproductiveness on the farms."

If you want a good cow, see that you spend a little time training and building up the calf; the habits wanted in the cow must be fixed in the heifer.—*Queensland Review.*

DAIRY EDUCATION ASSOCIATION.

Balance Sheet from 1st October, 1915, *to* 30*th September*, 1916.

Particulars.	Amount. Rs.	As.	P.	Particulars.	Amount. Rs.	As.	P.
To Printing charges	855	5	0	By Subscription and Sale of Journals	649	7	0
To Stamps	66	10	6	By Receipts on Account of Advertisements	160	0	0
To Packing and Freight ..	33	4	9	By Donations	98	4	6
To Establishment	117	4	5	By Fees for N. D. D. Examination	20	0	0
Subscription paid to Home Committee	166	0	6	By Amount due for Subscriptions	70	4	0
				By Amount due for Advertisements	40	0	0
				By Balance Debtor	200	9	8
TOTAL ..	1,238	9	2	TOTAL ...	1,238	9	2

LIST OF MEMBERS OF DAIRY EDUCATION ASSOCIATION (INDIAN BRANCH).

Alger, F. A., Government Military Dairy Farm, Rawalpindi.

Allan R. G., M A, Principal, Agricultural College, Nagpur, C. P.

Athalye, M. G, District Agricultural Officer, Nasik Raviwan Palli, Nasik City.

Bee, G. O., Keventer's Dairy Farm, Tara Devi, Simla, W

Bengali, B. S., L Ag., College Farm, Nagpur, C. P.

Betts, W., Government Military Dairy Farm, Karnal.

Bishan Dayal, Agricultural College, Allahabad.

Bostrom, W., Aligarh Dairy Farm, Aligarh.

Briddes, F. S, Government Military Grass Farm, Multan.

Bruen, Edw. J., Government Military Dairy Farm, Kirkee.

Carruth Allan, N. D. D, N. D. A., C. D A. (Glas.), P. A. S (Scotland), Deputy Director of Agriculture, Live Stock, Madras.

Chadwick, D. T., I.C.S., Director of Agriculture, Madras.

Chakravarty, J. N., Superintendent, College Dairy Farm, P. O Telamnagar.

Chinoy, K. P., Agricultural College, Poona.

Clancy, H. H., Government Military Dairy Farm, Peshawar.

Clark, W., Aligarh Dairy, Cashmere Gate, Delhi.

Claxton, Government Military Dairy Farm, Karnal, Punjab.

Clouston, D, M A., B.SC., Deputy Director of Agriculture Southern Circle, Nagpur.

Daniel, S., Experimental Farm, Hebbal, Bangalore.

Deputy Director of Agriculture, Mirpur Khas, Sindh.
Deputy Director of Agriculture, N. D., W. D., No. 16, Poona City.
Director of Agriculture, Bombay Presidency, Poona.
Duff, C., Government Military Dairy Farm, Bombay.
Frost, G. H., Superintendent, Government Military Dairy Farms, Southern Circle, Poona.
Garden, J. M., Government Military Dairy Farm, Ambala.
Ghale, L V., College Farm, Nagpur, C. P.
Ghare, B K., Agricultural Lecturer, Nawabganj, Cawnpore.
Gill, Government Military Dairy Farm, Cherat, N. W. F. P.
Gilling, H. T., Government Military Grass Farm, Meerut
Goffi, F., Imperial Laboratory, Muktesar, U. P.
Gokhale, V. G., L. Ag., Extra Deputy Director of Agriculture, Konkan Division, Ratnagiri.
Gonehalli, V. H., M.A. (Cam.), N.D.D.A., Assistant Registrar, Co-Operative Societies, Konkan Division, Thana.
Gregory, A. A., Government Military Grass Farm, Jullundur, Punjab.
Griffin, Don, 46, Park Street, Calcutta (Fertiliser Dept., Graham & Co)
Hallowes, F. W., Lt.-Col., Director of Farms, Army Headquarters, Simla
Hanmuante, N. V., B. Ag, Manager, Infants and Public Milk Supply Co, Limited. Dairy Farm, Palghar District, Thana.
Hari Bhan Mukati, P. O. Kutsi (Dhar State).
Hari Ram, L.Ag., Landowner, Haripur, Gangapur District, Lyalpur.
Harvey, R. I, B.sc., Assistant Director of Agriculture, S C., Nagpur, C. P.
Herbon, W. P., Government Military Dairy Farm, Kasauli, Simla Hills.
Higginbottom, Sam, M.A., B.sc., Director of Agriculture, Gwalior State, Kampur Kothi, Lashkar, Gwalior.
Horne, E. A., Government Civil Dairy, Kirkee.
Hulme, A. M., Government Military Dairy Farm, Deolali.

Jacobson, O., Senchal Dairy Farm, Ghoom, D. H. Railway.
Jaimul Singh, Agricultural Expert, Jhalawar State, Rajputana.
Joshi, Lemuel L., Dr., M.D, B.SC., D.T.M., F.C.S., Municipal Analyst, Bombay Municipality.
Karak Singh, M.A., Assistant Professor, Agricultural College, Lyallpur.
Kartar Singh, L.Ag, Agricultural College, Lyallpur.
Keatinge, G., I.C.S., Director of Agriculture, Poona.
Kelkar, G. K., Rao Sahib, Deputy Director of Agriculture, Poona.
Keventer, Edw., Proprietor of Dairy Farms, Aligarh, Simla, etc., Aligarh, U. P.
Keventer, W., Aligarh Dairy Farm, Aligarh, U. P.
Knight, J. B., Professor, Agricultural College, Poona.
Kulkarni, M. L., Rao Sahib, Acting Deputy Director of Agriculture, Southern Division, Dharwar.
Lamb, A., Government Military Dairy Farm, Aden.
Langley, F. H., Government Military Dairy Farm, Agra, U. P.
Lawrence, T. R., Proprietor, Stafford & Co., 5, Bellasis Road, Bombay. No. 8.
Lawton, J. W., Indian Dairy Supply Company, Bombay.
Mani Charan, V., Agricultural Instructor, Islamia High School, Vaniyambodi, North Arcot District.
Mann, H. H., Dr., Professor, D.SC., M.SC., F.I.C., Agricultural Chemist, Government of Bombay and Principal of Agricultural College, Poona (Chairman).
Marriott, A. S., Major, Assistant Director, Grass Farms, Lahore Cantonment.
Martin, H., Government Military Dairy Farm, Mhow.
McRae, W., Librarian, Agricultural and Research Institute, Lawley Road, Coimbatore.
McSwiney, J., B.A., I.C.S., Director of Agriculture, Shillong.
Meik, Donald, B.SC., c/o Graham & Co., Calcutta.
Mellor, Major, Assistant Director, Grass Farm, 7th (Meerut) Division, Meerut.
Morley, J. J., Government Military Dairy Farm, Allahabad.

Mortenson, Aligarh Dairy Farm, Aligarh, U. P.
Mukhtar, Nabi, Department of Agriculture, Jullundur.
Narsingh Raju, C., Dairy Inspector, Experimental Farm, Hebbal, Bangalore.
Narsingh, Rao Shitoli, Agricultural College, Allahabad.
Newman, B. J., Government Military Dairy Farm, Cawnpore.
Osborne, R., Government Central Creamery, Ahmedabad.
Patel, R. T., Government Military Dairy Farm, Wellington.
Paton, A. M., Government Military Dairy Farm, Bangalore.
Patuck, N. H., Bombay Dairy Supply Company, Grant Road, Bombay.
Phatak, B.A., Lecturer, Agricultural College, Nagpur, C. P.
Power, W., Government Military Dairy Farm, Rawalpindi.
Pownall, J., Government Military Grass Farm, Kasauli.
Pundit, B. S., Agricultural Department, Thana.
——————— Professor of Agriculture, Agricultural College, Poona.
Rajah Ram Vaish, Agricultural College, Allahabad.
Ramaiya, K., L.Ag. (Honors), 60, Sunkalpet, Bangalore.
Rao, B. S., Final L.Ag., Student, Nagpur, C. P.
Reeves, W., Indian Dairy Supply Company, Nadiad.
Riddick, H. J., Manager, Government Military Dairy Farm, Quetta.
Ritchie, H. J., Officiating Deputy Director of Agriculture, Northern Circle, Jubbulpore.
Roberts, W , B.Sc., Professor of Agriculture, Lyallpur.
Robertson-Brown, F.R.H.S., Agricultural Officer, Taru, N. W. F. P.
Robinson, J., Government Military Dairy Farm, Dagshai.
Rouse, S. W., Government Military Dairy Farm, Ruk.
——————— Registrar, Department of Revenue and Agriculture, Simla.
Sardar Harcharan Singh, L.Ag., Spring Field, Kasauli.
Shaw, H. T., Indian Dairy Supply Company, Nadiad.
Shevadi, S. W., B.Sc., Superintendent, The Model Dairy Farm, Talegaum.

Shiragker, V. V., B.Ag., The Farm, Belgaum.
Sitole, M. M., Director of Agriculture, Baroda State.
Smith, W., Assistant Director, Government Military Dairy Farms, Southern Circle, Poona.
Spearman, A. H., Government Military Dairy Farm, Sialkote.
Stanford, T. J., Government Military Dairy Farm, Lucknow, U. P.
Sultan Rao, Muharkar, Agricultural College, Allahabad.
Suryabansi Babu Rao, Agricultural College, Allahabad.
Syed M. W. Ravazi, Agricultural College, Allahabad.
Takle, I. V., N.D.D., Agricultural College Dairy, Nagpur, C. P.
The Globe Dairy Co., 20, Charni Road, Girgaum, Bombay.
The Manager, Bengal Co-operative Journal, Writers' Buildings, Calcutta.
The Secretary of the Agricultural Association, Kumbakonam, Madras.
Thorne, W. A., Government Military Dairy Farm, Lahore Cantonment.
Traynor, F. E., Government Military Dairy Farm, Kirkee.
Uma Charan Pardhan, Agricultural College, Allahabad.
Walker, A. M., Government Military Dairy Farm, Rawalpindi.
Walker, H. G., Major, C.I.E., F.R.C.V.S., Superintendent, Veterinary Department, Poona.
Wells, H. J., Government Military Dairy Farm, Jubbulpore.
Willsher, A., Government Military Dairy Farm, Ambala.
Wynne Sayer, B.A., Assistant to Agricultural Adviser to Government of India, Pusa, Behar.
Yuill, A. F., Indian Cotton and Oil Co., Ltd., Navsari.

List of Associates of the Dairy Education Association, Indian.

Baroda Sundarpal, Nawab's Estate, Comilla.
Bormanjee, K. R., I.C.S. (Retired), Administrator, Cambay State.
Byramjee Pestonjee, Nagpur, C. P.

Case, B. C., A. B. Mission, Pyinmana, Burma
Chandarwarkar, G. H., Pleader, Belgaum.
Chunilal D. Mehta, c/o Postmaster, Bandra, Bombay.
Crawford, F. L B., Acting Political Agent, Raipur, C.P.
Crawford, M. M., Shikarpore.
Crosthwaite, A. R., Registrar, Co-operative Societies, Jubbulpur.
Damli, K. G., Rao Sahib, Chairman, General Bank, Akola.
Devyada Datta, Office of Director of Agriculture, Bengal. Chittagong.
Dubash, K. M., F.R.C.S., Managing Director, The Infants and Public Milk Supply Company, Limited, 12AA, Charni Road, opposite Cama Bagh, Bombay.
Evans, A. C., C.E., Midlakes Sat Tal, Kumaon, U. P.
Farrell, A. H., Student, Government Dairy Farm, Bangalore.
Frost, E G., Dentist. Langdale, Westbourne Crescent, Southampton.
Frost, S., c/o S. Frost & Co., Ltd., Kennington Park Road, London, S.W.
Fyfe, W. S., Mechanical Engineer, Government Military Dairies.
Gajjor, T. K., Techno-Chemical Laboratory, Lundar.
Gibson, N. S., Student, Government Dairy, Quetta.
Holton, D R., Student, Government Dairy, Kirkee.
Jayaji Protap, Moti Mahal, Gwalior, C. P.
Jones, F., Deodars, Bhim Tal, Kumaon, U. P.
Joshi, S. N., Ratnagiri
Kennedy, J. S., Student, Government Dairy, Mhow.
Laksmi Ratan, R. V., Jun., Merchant and Agent, 316, Thambuchatty Street, Madras.
Maebahul Osman, Syed, Assistant Registrar, Co-operative Societies, Central Provinces and Berar, Jubbulpore, C. P.
Mahamad Akram Khan, Lambardar, P. O. Charsada, District Peshawar.
Managing Director, Laksmi Oil Mill Company, Akola.
Mani Lal B. Nanawatti, Director of Commerce, Baroda.
Manicka, V. G., Chengalreya Mudali, Nellore, North Arcot Dist.

Maung Bash, Resident Excise Officer, Henzada, Burma.
Maung Po Yen, 2nd Master, Government High School, Henzada, Burma.
Meik James, P., Rev., Methodist Episcopal Church, Bolpur, E. I. Ry.
Milhalland Paul, B.SC., Shahjahanpur.
Mudaly, D., Day Boarding Master, B. T. N. High School, Mandalay.
Natabur Mondul, D. C., Mellar & Co., Clive Road, Calcutta.
Rao Sahib Pundit Mati Din Sukul, Executive Engineer, P. W. D., Nadia Rivers Division, Behrampur, Bengal (E. B. Ry.), District Murshidabad.
Ruddock, C. P., Student, Government Creamery, Ahmedabad.
Samirer, P. Pasamauli, Madura, Madras Presidency.
Sardari Lall, Office of A. D. D. F , N. C.
Shri Ramulu Vastry, B.A., B.L., High Court Vakil, Madras.
Skelton, C., Engineer, Jodhpore.
Stewart, H. W., Student, Government Dairy Farm, Lucknow.
Stovold, R., Student, Government Creamery, Ahmedabad.
Veale, H. W., Student, Government Dairy, Rawalpindi.
Woodford, R. C., Student, Government Dairy, Quetta.
Zurhanson, I. G., Revd. Father, Senior, R. C. Mission, Anand.
Zutshi, J. N., F R.H.S., F.R.B.S., Forest Officer, Morar, Central India.

All correspondence regarding the Journal, advertisements, etc., should be sent to the Hon. Secretary, Dairy Education Association, No. 12, Victoria Road, Poona.

This Journal is issued Quarterly, in October, January, April, July.

RATES OF SUBSCRIPTION.

Membership to Association	...	Rs. 5-0-0
Annual subscription to the Journal	...	,, 4-0-0
Single Copy, including postage	...	Re. 1-0-0

ADVERTISEMENTS.

			Annual.	One issue.
Full	page	...	Rs. 20-0-0	Rs. 6-0-0
Half	,,	...	,, 13-8-0	,, 4-0-0
Quarter	,,	...	,, 7-0-0	,, 2-0-0
6 Lines	...	...	,, 3-0-0	Re. 1-0-0

SUB-COMMITTEE FOR INDIA.

CHAIRMAN.

Dr. HAROLD MANN, D.SC., M.SC., F.I.C., K. H. Gold Medallist, *Principal, Agricultural College, Poona, and Agricultural Chemist to Government of Bombay.*

MEMBERS.

WILLIAM SMITH, Esq., *Assistant Director of Government Dairy Farms, Southern Circle, Poona.*

D. CLOUSTON, Esq., M.A., B.SC., *Deputy Director of Agriculture, Nagpur.*

H. J. RIDDICK, Esq., *Manager, Government Dairy Farms, 4th (Quetta) Division.*

EDWD. KEVENTER, Esq., *Proprietor of Dairy Farms, Aligarh, Simla, etc.*

W. REEVES, Esq., *Indian Dairy Supply Coy., Ltd., Bombay, Nadiad, etc.*

R. OSBORNE, Esq., *Manager, Government Central Creamery, Ahmedabad.*

G. H. FROST, Esq. (Hon. Secy.), *Government Military Dairies, Southern Circle, Poona.*

DAIRY EDUCATION ASSOCIATION.

——————191 .

THE HON. SECRETARY,

DAIRY EDUCATION ASSOCIATION,

(INDIAN BRANCH),

POONA.

Dear Sir,

I wish to become a member of the above Association, and if elected agree to promote the welfare of the Association to the best of my ability and to remain liable for my subscription until I shall notify the Hon. Secretary of my resignation. On receipt of your letter advising me of my enrolment as a member, I will forward the subscription of Rs. 5 to the Hon. Secretary (Mr. G. H. Frost, Government Military Dairy Farms, Poona), and yearly on October 1st, or otherwise accept the 1st issue of the Journal by V.-P. P.

Dairy School or Schools attended and length of time of instruction.

....

....

Dairying Certificate, Diplomas, etc.

....

....

(Signed)..

Mr., Mrs., or Miss, etc.

Permanent Address..

....

VOL. IV, PART II. QUARTERLY. JANUARY, 1917.

THE JOURNAL OF DAIRYING

AND

DAIRY FARMING IN INDIA

DAIRY EDUCATION ASSOCIATION

D. E. A.

Printed by Thacker, Spink & Company, 6, Mangoe Lane, Calcutta, and
Published for the Committee, Dairy Education Association in India.

CONTENTS

THE

JOURNAL OF DAIRYING

and

Dairy Farming in India.

VOL. IV.—PART 2.] QUARTERLY. [JANUARY, 1917.

EDITORIAL.

IN the current issue will be found a list of successful members of the Association who sat for the Indian Dairy Education Association Diploma in December last. Ten candidates sat for the examination, out of which four secured the Diploma.

The examination questions for the Diploma are published, and some of the best answers selected from the papers will be published in our next issue. This we hope will afford some instruction to members studying for the next examination.

The syllabus of the subjects required to be studied for the examination, and a list of text-books is also republished in this issue.

We are glad to see in the New Year Honours the name of our energetic Chairman, Dr. H. Mann, D. Sc., who has been honoured with the Kaiser-i-Hind Gold

Medal. The Association desire to congratulate Dr. Mann, whose work is too well known in the agricultural world to need any comment here.

A review on Bulletin No. 78 "Some Wild Fodder Plants of the Bombay Presidency" by Dr. Burn and Messrs. Bhide, Kulkarni, and Hanmante will be found in this issue.

We recommend our readers to carefully study this Bulletin, as it will be extremely useful in both agricultural and dairying circles.

* * *

IN the opinion of some, dairy-farming is a very simple matter, and it has been suggested from more than one quarter that our disabled soldiers might turn to this as a livelihood if unable to follow their ordinary avocations. Dairy farming is not, as some people apparently imagine, merely a matter of keeping milch cows, of milking them twice a day, and of despatching well-filled cans to town, and then waiting for fat cheques by way of profit. It is really a somewhat harassing business, full of unsuspected problems to those unacquainted with the inner working of the milk trade. The up-to-date farmer must have a sufficient smattering of scientific knowledge to understand the different values of foodstuffs for his cows, and the effects they may produce on the quality as well as the quantity of the milk yielded by the herd.

The dairy farm itself is run on scientific lines, with machinery, labour-saving appliances, and all sorts of labour-saving devices for keeping the milk clean and uncontaminated. Some of the great dairy farms of this country are show places, inspected and admired by visiting agriculturists from all parts of the world.

The above may be realised if one attempts the examination for the N. D. Diploma or even if one peruses the papers set for the last examination. It, however, takes more than a man who may be able to sit down and answer all the questions, for he must be a persistent hardworker, with an abundance of good sound commonsense; without these he is a failure no matter how much theoretical knowledge he may have.

DISINFECTION OR HYGIENE ON THE DAIRY FARM

BY

MR. G. H. FROST.

Continued from page 11.

IN our last Journal, we dealt to some extent with the prevention of Infection; but as this may not have been successful, we must know something of the methods necessary to employ in removing it. These measures are numerous and complicated, since they depend considerably on what has become infected, and by what organism.

The most serious infections are those of the blood, but scientists have been, and still are working hard to ascertain means by which the blood may be freed from infections by various bacteria and parasitics; fortunately they have succeeded to a great extent in dealing with some of the most serious diseases. This branch of science is chiefly dealt with under "Immunology." This is again a branch of "Bacteriology": it would therefore be to our advantage to know something of this subject: in fact "Disinfection" and "Hygiene" cannot be thoroughly understood without a knowledge of this science. It is therefore strongly advised that all dairy farmers be given some elementary studies in this matter. If this is impossible, then it is recommended that our readers purchase a small book "Lessons in Disinfection and Sterilization" by F. W. Andrews, M.D.: the cost is only 3*s*. 6*d*. The following few extracts will illustrate the necessity of such a book:—

"Sterilization and disinfection play so important a part in modern medicine, surgery and public health, that these principles require to be understood by those who would practise them intelligently. They are problems

in physics and chemistry applied to bacteriology, and can only be grasped from this point of view. The majority of those who are called upon to practise them have neither time nor opportunity for a complete course of bacteriological study; but it is not a difficult thing for a teacher to devise a short practical course of laboratory instruction, which shall effectively teach the essential principles of disinfection. I have endeavoured in these pages to set forth the outlines of such a course.

"*Spore Formation* is not so much a method of multiplication as the development of a resistant resting stage. True spores are not formed by coccic, but only by rod-shaped bacteria, and only by some of these"

"The object of spore formation is evident. Its distinct outline and bright appearance are due to the possession of a thick coat or capsule of a very impenetrable kind, which does not easily allow heat or injurious chemical agents to get at the living protoplasm within. Stains penetrate the resistant capsule of the *spore with extreme difficulty*. It will presently be seen that what is true of dyes is also true of disinfectants. Spores may live for years in the dried condition. When the danger is over, the drought past, and the surroundings again suitable for active life, the spore germinates. Its thick capsule ruptures and the protoplasm within grows out into a new bacillus.

"The importance of spores in all questions of disinfection is thus very great, because they are many times as hard to kill as the growing forms of bacteria.

"In cultivating bacteria in the laboratory, it suffices, for ordinary purposes, to maintain two incubators—one with a constant temperature of about 70°F., for the first group, and one with a constant temperature of about 98°F. for the second.

"In all cases growth ceases long before the freezing point of water is reached, and if we except a few abnormal cases, no growth occurs above 110°F.

"*Light* is the most important of the other physical conditions, which influence the growth of bacteria. They love darkness rather than light. It follows that the admission of sunlight is a valuable thing. Koch found that the tubercle bacillus was killed by direct sunlight in a few hours."

It is important to bear in mind that bacteria are not given off to the air from moist surfaces: they only pass off when dried. In quiet breathing they do not pass out in the breath, though in talking, conghing, and sneezing, minute particles of fluid are necessarily ejected and may be carried for some distance in the air. This has been shown by a simple but effective experiment. There is an organism known as "Bacillus Prodigiosus" not often found in air though common in the soil: its Colonies are of a vivid crimson colour, and are hence easily recognisable. It is quite harmless. In an experiment carried out in the House of Commons, Gordon showed that every part of the Debating Chamber was infected by "bacillus prodigiosus" when a person who had previously washed out his mouth with a culture of that organism spoke for an hour on the floor of the house. Even the galleries were infected. Similarly, it has been proved in a splashing experiment with sewage, that the air may be infected with sewage bacteria.

"Two familiar instances of bacteria, which can live outside as well as inside the body though preferring the latter, are found in the typhoid bacillus and the vibrio which is the cause of Asiatic cholera."

A little reflection on the foregoing facts will show that the habit of life of the particular bacterium, which causes any given disease, must exert a great influence upon the way in which that disease spreads, and must correspondingly effect that plan of campaign in our attempts to stamp it out. A few examples will illustrate this:—

1. The range of action of the gonococcus, viewed as an infective agent, is an extremely limited one, and it would be correspondingly easy to stamp out the disease by suitable measures of isolation and disinfection. It is a directly contagious disease.

2. Again, let the infective agent be a strict parasite, but one capable of considerable resistance outside the body, able to withstand drying for weeks or even years, without losing its vitality. The "anthrax bacillus" is such an organism. There is some evidence that it may, under favourable circumstances, multiply outside the animal body, though its power of doing so

is limited, but its spores can remain dormant in the soil for years. The tubercle bacillus is another: it is not clear that it forms spores but it is certain that the dried "tubercle bacilli" remain living and virulent for many weeks. This persistence of vitality for long periods outside the body greatly increases the range of action of such bacteria as infecting agents, for in addition to direct, it confers vast opportunities for indirect, infection. An animal that has died of anthrax may infect a pasture for years, so that other animals grazing there are liable to be attacked.

3. "There is a third group of diseases in which the infecting agent is not a strict parasite, but an organism capable not merely of maintaining its vitality, but of growing and multiplying as a saprophyte outside the body. The typhoid bacillus and the cholera vibrio have been mentioned as cases in point. There is good reason for believing that, after an attack of typhoid fever, the specific bacilli may similarly go on living for many months as saprophytes in the intestines."

"The foregoing illustrations must serve to indicate the extreme importance of an accurate knowledge of the habits of life of the different disease-producing bacteria if an intelligent war is waged against the diseases they produce. If that war could be waged only by means of sterilisation and disinfection, the outlook would indeed be gloomy, for the foe is so numerous, so ubiquitous, so resourceful, and often so resistant, that the prospects of its termination seems hopeless. Fortunately there is another side to the question."

The above extract will help us to see the importance of the various sciences in dealing with infection. We will again continue with our subject of "Immunity," one of the most important means available to stamp out disease.

* Immunity is, broadly speaking, resistance to disease. It is usually restricted to infectious diseases and signifies a state of the individual, which enables it to successfully defend itself against the invasion of its tissues and organs with the invading micro-organisms or to resist

* *Note.*—An excellent article on "Immunity" may be seen at page 204 of "Dairying and Dairy Farming" by members of the Dairy Students' Union. A most useful work for Indian Students.

their toxic effects, should they gain entrance and multiply within the body. It usually applies to the action of pathogenic bacteria, but the protozoa are also included.

The degrees of Immunity are as follows :—

(1) Natural Immunity.
(2) Artificial Immunity.
(3) Active Immunity.
(4) Passive Immunity.

(1) *Natural Immunity* is the ability possessed by some animals. which enables them to resist the natural invasion of infecting organisms that attack other varieties or species of animals It is considered to be an inherent condition in the nature of the individual and is transmittible to its progeny. Blackleg, which is very destructive to cattle, does not attack horses, carnivora or man Ruminants are immune from glanders; man is not. Rinderpest attacks only ruminants.

(2) *Artificial Immunity* is brought about after birth of the individual, either by recovery from a natural attack of a disease such as—

(1) Contagious abortion.
(2) Anthrax
(3) Blackquarter.
(4) Pleuro-pneumonia, contagious.
(5) Diphtheria.
(6) Foot-and-mouth disease.
(7) Piroplasmosis
(8) Rinderpest.
(9) Hæmorrhagic septicæmia.
(10) Tetanus.

Immunity may also be acquired by causing the animal to pass through an attack of the disease—

(*a*) By inoculating the individual with a non-lethal dose of a strong virus. This is practised in immunising cattle against piroplasmosis, contagious abortion, contagious pleuro pneumonia.

(*b*) By inoculating the individual with attenuated virus. This is practical in anthrax, blackleg, and probably in bovine tuberculosis.

(*c*) By the injection of toxins and antitoxins simultaneously as for rinderpest and anthrax.

The above methods are considered to cause *Active Immunity.*

When Immunity is produced by the injection of serum (antitoxis) it is called *Passive Immunity.*

Active Immunity is slow in its appearance and is more or less dangerous to produce. It varies in the time it lasts, but is usually persistent, lasting from several months to several years.

Passive Immunity is quite rapidly produced, is attended with little or no danger, and practically no discomfort.

The most extensive use of Passive Immunity is in immunising cattle on the outbreak of rinderpest and hæmorrhagia septicæmia. This system is being rapidly extended in this country since the Imperial Bacteriological Laboratory at Muktesar is able to produce serums. This laboratory is not being used to the extent it might be, since we are not prepared with slides and sterile pipettes in which to send up materials for examination and diagnosis. If this was done, it would be possible to extend the preparation of serum. There is a most admirable staff waiting and ready to undertake anything in their own province. The European staff are from the most famous laboratories in London and are just pining for work on new diseases or lines of discovery. The Imperial Bacteriologist being a man of renown having been till recently a co-worker with Sir John McFadyean in the Royal Veterinary College, London, proves that the Indian Government are doing all they can to conquer disease in this country and help all who want to be helped, and add their quota to the world's research. I am grateful for having had the opportunity to study at this laboratory, and any useful remarks there may be in this article are due to their instruction, which was given ungrudgingly and thoroughly. They only ask for co-operation in the field where they cannot go themselves: it is for us to do all we can to send along materials, when we are in difficulties and get their assistance.

The investigations of this institution and scientists in other parts of the world are upon most difficult subjects, which will help us and all who have to deal with cattle. The demands for serum are not enough

to keep this vast establishment at full swing, yet there are cattle dying in the country for want of it. It means, of course, that there are not enough trained Veterinary Surgeons to meet the requirements, and unfortunately the average Indian does not see the need of them, and if he did he cannot afford to pay anything towards an increase, and it is certain that if he gets it free he cannot appreciate it.

The following are the chief bacterial and other diseases of the blood and tissues :—

(1) Actino-mycosis (Fungoid).
(2) Anthrax.
(3) Barbonne.
(4) Blackquarter.
(5) Piroplasmosis (Protozoa).
(6) Diphtheria in calves.
(7) Foot-and-mouth disease.
(8) Enzootic abortion.
(9) Pseudo tuberculosis or Johne's disease.
(10) Malignant œdema.
(11) Malignant catarrhal fever.
(12) Surra-Trypanosome (Protozoa).
(13) Parasitic mycotic stomatitis (Fungoid).
(14) Pleuro-pneumonia, Bovine
(15) Pneumono-mycosis aspergillia (Fungoid).
(16) Rinderpest.
(17) Tetanus
(18) Tuberculosis, Bovine.
(19) Septicæmia hæmorrhagia.
(20) Vesicular exanthema of cattle.
(21) Dysentery "white scours" in calves.

Vaccines are sometimes used, but they are dangerous to some extent, the dangers being as follows :—

(1) The vaccine may be too much attenuated, resulting in the failure to establish immunity.
(2) The vaccine may be too strong (virulent) so that it will produce more disease than is desired, possibly causing death ; or at least a very serious attack.
(3) In using non-lethal doses of virulent virus, the danger of producing fatal results, because of the uncertainty of the degree of susceptibility of the animal.

(4) In the simultaneous method the danger of accident resulting from too strong virus, too weak serum, or unusual susceptibility of the animal must be kept in mind. Chemicals have been used to some extent to remove infection from the blood, but it is too risky an experiment for dairy farmers.

We have considered infection to some extent, where it is the blood and tissues that are effected. We have now to consider measures to remove infection from—

(1) The skin and intestines of animals when affected with parasites, etc.
(2) The sheds in which cattle live.
(3) Grazing grounds.
(4) Clothing and stable utensils.
(5) Attendants.
(6) Manure bedding and refuse food.
(7) The dairy and all utensils used for milk.

In the above it may be possible to use much stronger measures, such as—

(*a*) Fire
(*b*) Steam.
(*c*) Sunlight.
(*d*) Boiling water.
(*e*) Chemicals.
(*f*) Gases.
(*g*) Electricity.
(*h*) Ultra-Violet Rays.

(1) The skin and intestinal organs of animals may be infected by (*a*) Bacteria, (*b*) Fungoids, (*c*) Protozoa, (*d*) Vermes, (*e*) Acarina, (*f*) Aptera, (*g*) Brachycera.

(*a*) The bacterial diseases have already been enumerated above.

(*b*) Fungoid diseases are—
(1) Actino mycosis
(2) Mycotic stomatitis.
(3) Mycosis aspergillia.
(4) Ringworm (Favus) (trichophytosis).

(*c*) Protozoa—Coccidium oviforme causes a disease of the intestines; the remaining are given with bacteria above.

(*d*) *Vermes* (worms).
(1) Tænia echino coccus (cysts) ... Liver, etc.
(2) Tænia expansa ... Intestines.
(3) Tænia alba ... Intestines.
(4) Tænia planissima ... Intestines.

(5) Tænia Cænurus ... Brain.
(6) Strongylus contortus ... Abomasum.
(7) Strongylus gracilis ... Gastritis and Enteritis in yearlings.
(8) Strongylus convolutus .. Abomasum.
(9) Strongylus micrusus ... Bronchitis and Hoose in calves.
(10) Ascaris vitulorum ... Stomach and intestines of calves.
(11) Distomum lancelatum ... Liver.
(12) Distomum bilharzia crassa ... Interitis.
(13) Filaria cervina ... In the eye.
(14) Filaria medinesis (Guinea-worm) under skin.

(*e*) *Acarina* (Mange-ticks)—
(1) Pesoroptic mange.
(2) Smybiotic mange
(3) Ixodis redvoius-ticks ... } Transmit
(4) Rhipicephalus amulatus-ticks ... } piroplasoms.

(*f*) *Aptera*—
(1) Himatopinus vitili (lice).
(2) Trichodectes scalaris (lice).

(*g*) *Brachycera* (flies)—
(1) Tabanidea (Breeze flies) carry Surra and Anthrax.
(2) Muscidea (House flies) carry all diseases.
(3) Ostridæ (Warble or Botfly).

To overcome infection from any of the above is a formidable undertaking. We have indicated the methods under prevention of infection which, if acted upon when infection appears, will go a great way towards their eradication on infection. Under (*a*) we have already stated that serums are the only effective means so far, and each disease must be studied separately from some good work Under (*b*) we can deal with ringworm with "iodine" or other disinfectants. The other diseases must be studied as at (*a*). Under (*c*) the same as for (*a*), except coccidium oviforme for which treatment is not unlike that for worms in intestines. Under (*d*) the therapeutic treatment varies with each organ affected; for echino coccus cysts and distomiasis there is no treatment. The parasites in stomach or intestines may be removed by anthelmintics followed

by purgatives; nearly the whole of the parasitic diseases are caused by damp low-lying pastures; therefore when the disease appears in any form, keep cattle and calves from grazing until the land is drained or dried up. It may be noticed that casualties from obscure causes are usually most numerous in the monsoon in India. Dogs are the chief carriers of tænia echinococcus: it is therefore imperative that dogs should be kept off farm premises as far as possible.

Treatment by chemicals is often very effective—lysol, turpentine, chloroform, creoline, salol, thymol, carbolic acid being the chief agents. The doses, etc., will be found under the diseases where symptoms, habits, and therapeutics are dealt with.

Under (*e*) we have mange and ticks—the former may be overcome with disinfectants rubbed in: the one most useful, perhaps, is formalin and glycerine mixed with water. The latter is best dealt with in dips or by sprays of disinfectants.

Under (*f*) we have lice which are usually easily dealt with by ordinary attention—clipping of hair, spraying with disinfectants, and general attention to health.

Under (*g*) we have the flies—the house-fly we have already dealt with in our first portion of this article. The Warble or Botfly can only be controlled by preventing the larva from leaving its host alive: this may be done by smearing the back with a thickish greasy unguent sufficiently soft to enter the breathing holes without melting and getting away: this will suffocate the larva under the skin.

2. *Sheds and standing for cattle* should as far as possible be constructed of iron or steel, reinforced concrete only, so that they may be disinfected by fire, should an infectious disease occur within them, this being the most effective method. After well firing, the floors should be sprayed with corrosive sublimate (1 in 1,000) and all corners, recesses, cracks, etc., well cleaned and saturated. Corrosive sublimate must not be used on iron or steel, all such structural materials should be sprayed with carbolic solution (1 in 100). When these measures are completed, the shed should be allowed to dry thoroughly, allowing as much sunlight in as

possible. The whole place should then be carefully whitewashed with freshly slaked lime and the crevices and corners thoroughly cleaned before applying this.

By shed and standings it is understood that they include mangers, walls, drinking troughs, drains, and the immediate vicinity.

3. *Grazing grounds* are often infected with vermes, fungoids, and other parasites, including bacteria. These are most difficult to deal with owing to the large area and the difficulty of dealing with soil.

Dressings with lime, resting the area from cattle, ploughing, leaving a good aftermath to dry, and then burning with all shrubs, etc., should be cut down and, when dry, burnt with the grass. These are all methods which assist in removing infection The frequent use of the dip will considerably reduce, and with perseverance may in time altogether remove, the tick pest.

Land which is found infected with strongylus, ascaris, coccidium, distomum, etc., should be well drained and treated with lime, and kept free of cattle for some time, and never be grazed in wet weather.

Soil or land on which anthrax cases have died should be fenced in by wire and a fire burnt over it for at least ten hours. The spores of anthrax being most difficult to destroy, the animal should be burnt on the spot where it dies, and not moved, if possible, as its blood would be full of organisms of the disease which would sporulate when death occurred.

Sunlight will kill most microbes but not anthrax, blackquarter, or tetanus which are most resistant owing to their power to sporulate, especially if they are covered with a few inches of earth. Anthrax spores are perhaps the most difficult to deal with : steam is said to kill them in about ten minutes, or a five per cent. solution of carbolic acid in ten to forty days. Corrosive sublimate (1-1,000) is said to kill them in eighty minutes.

4. *Clothing and stable utensils*, including *jhools*, should be burnt in preference to any method, but if this cannot be done, they should be baked in a dry sterilizer or other oven, or boiled for an hour in soda water.

5. *Attendants* are very difficult to deal with in an outbreak: they must therefore be carefully watched during this period, and when it is over they should be made to bathe in hot water with soda and soap added, and to finish up with, they should wash in a 5 per cent. solution of carbolic acid.

Then clothing should be changed and dealt with as above.

6. *Manure, bedding, and refuse food* should *all* be burnt at once and not be allowed to blow about; it should, as far as possible, be burnt on the spot of infection, so that all germs may be destroyed

7 *The dairy and all utensils used for milk* are often the means of causing infection, unless kept most scrupulously clean. It is here that steam and boiling water play a most important part, and no dairy should be without a boiler, small or large, to suit its capacity. Washing soda is a most excellent chemical in the dairy: it searches the corners if good hot water is used in conjunction therewith. It also neutralises the acid and loosens dirt—this followed by a good steaming is fatal to micro "organisms." It is, however, a good thing to have a room in large dairies made of good cement concrete or iron facing to a brick wall on all six faces, and fitted with iron shelves for the well-washed cans, bottles, brushes, and every utensil used in the dairy, or delivery carts, in the cattle yard and elsewhere, racks or grids for the floor, so that large utensils, drums, etc., can stand on them; a well-fitting door with two small windows, one at the top and another at the bottom. This room would be fitted with a steam jet, which could be turned on when closed up and kept at a temperature of 200°F. for a couple of hours, and then the two windows could be opened and the steam allowed to escape and the room cooled down so that the cans, etc., could be taken out and cooled when required. This procedure would ensure the sterilization of all utensils and bottles, the latter being difficult to steam in any other way. This method also ensures all being steamed sufficiently long which is not always the case when each vessel, etc., is done individually

The dairy floors and drains should, after being thoroughly washed down with scalding water and soda

and, if possible, scrubbed with soap to loosen and remove all dirt, be sprinkled or, better, sprayed with a garden syringe occasionally, and thoroughly with a formalin solution 1 in 500. This treatment may be alternated with a sprinkling of fresh unslaked lime. The above procedure is very necessary in a cold store.

It is presumed that all milk is pasteurised to 180°F. for two minutes and rapidly cooled. The average dairy has its coolers or refrigerators exposed to the atmosphere; it will therefore be apparent how very essential it is to have the atmosphere of a dairy pure. We have suggested means for this already, but we have the outside dust to contend with: this is best overcome by dairies being well away from main roads, frequented thoroughfares, and by the dairy roads being well watered twice daily. It is a good sanitary measure and pays for itself by preserving the roads.

No native dairy employé should be permitted to wear his own clothing in the dairy, nor should he be allowed home with the dairy clothing. This should be white, and changed daily: a changing and washing-room is therefore an essential to a good dairy.

A dry sterilizer should be kept in every dairy, which could be used for sterilizing dairy men's clothing, jharans, dairy muslin, and other things, which cannot be steam sterilized.

Electricity and ultra-violet rays have been and are being used for sterilization of milk, etc., but it is so far too expensive for commercial purposes. Freezing does not kill bacteria, but only stops their growth for the time being.

We have considered the disinfection of the eight various subjects that may become infected; it now remains to be indicated which are the most useful chemicals.

In the effort to destroy micro-organisms in such places as already mentioned, it is necessary to consider, before applying a disinfectant, the following :—

(1) The resistance of the particular organism to be destroyed.

(2) The medium or material in which it exists.

(3) The nature of the place containing the organism to be destroyed.

(4) The chemical action of the material surrounding the micro-organism itself.

Microbes live more securely in cracks and corners than on the much worn intact floor: it is therefore necessary to use a stronger solution where such exist.

A strong solution of chloride of lime may be classed as one of the quick acting disinfectants for most bacteria: it will not, however, destroy the infection of tuberculosis and glanders.

The following are the most effective disinfectants in the chemical group for destroying bacterial infection; also for wounds, parasites, vermes, etc.:—

(1) Carbolic acid, to which some salt should be added.
(2) Corrosive sublimate, to which some salt should be added.
(3) Unslaked lime.
(4) Iodoform.
(5) Salt solution.
(6) The phenol group—Lysol, Crelin, Thymol, Salol.
(7) Formalin—40 per cent. of Formaldehyde
(8) Boric acid.
(9) Permanganate of potash (Condy's fluid).
(10) Carbonate of soda and soap.
(11) Creosote and phenyle.
(12) Salicylate acid, santanin.
(13) Alcohol.
(14) Chlorine gas and its salts; sulphur fumes.

We hope to get one of our members to give a short account of the various diseases mentioned on pages 67 and 68 in due course.

BUTTER-MAKING ON THE FARM.

BY

R. C. WOODFORD, N.D.D. (I.).

A STORY is told of natives of the frozen district towards the North Pole; they, it is said, partly fill a skin bag with milk and suspend it from the roof of their particular dwelling place; the family then gathers, and sitting in a circle, hit the bag lustily from one to the other, until the contents change into a lump of butter of sorts and a quantity of liquid containing the remaining constituents of the milk. This demonstrates forcibly the governing principle in all butter-making, that concussion causes cohesion of the fat globules into units of larger size. From methods such as the above many mechanical aids have been developed to produce an efficient and speedy cohesion of the fat globules in milk, gradually working up to the separating machine, the end over end churn, and the roller worker. All other forms of churns—round, oval, those containing beaters and appliances inside—have to a great extent been superseded by the end over end churn for hand churning.

The making of butter direct from milk died out when it was found that better results in outturn, in quantity, and in rapidity of making, might be obtained by using to a large extent only those constituents which are required to produce butter.

The ripening of this liquid, known as cream, (or the production of lactic acid in the cream), was found to produce a more captivating flavour than in the case of fresh cream. Ripening may be achieved naturally by allowing the cream to stand for the time needed by the lactic-acid-forming bacteria to break down part of the lactose, and produce the acid to an amount of, according

to the best authorities, ·4 per cent. of the whole quantity of cream. During this time it is possible to greatly help the bacteria in their work, by keeping the cream at the 'optimum' temperature of that particular species of bacteria, that is about 70° Fahrenheit. It is considered dangerous to keep cream in a cold store, since anaerobic bacteria are present there, and produce putrefaction in cream instead of ripening it.

Science has proved that it is more satisfactory to control the ripening by the introduction of a pure culture than by natural methods. By the addition of a pure starter, ripening is controlled to a given time for a given quantity. To use this culture to the best advantage the cream is pasteurised while in the milk, thus reducing the number of active bacteria and giving the culture a more or less clear field for development.

It is not within the scope of this article to go deeply into the particulars of using these 'starters,' since they are many and varied, and each maker gives detailed instructions for the use of his culture.

Cream must be kept thin and well stirred to enable good ripening; it has a natural tendency to thicken and needs watching.

The test for the correct amount of acidity in cream for churning is often done by taste and smell. To turn out a uniform and high-quality butter, however, the chemical test should be made. In this Journal under 'Tests for the Dairy' will be found a simple chemical test for acidity in cream.

The final preparations of the cream for the concussion inside the churn are made immediately before churning. It may be necessary to thin down a little more, and the temperature must be reduced to the churning temperature, which is about 60° Fahrenheit, varying a little above and below inversely as the temperature of the air is above or below the average.

Colouring is a question which arises at this point; this is merely a public prejudice but has become general. A pale primrose is the colour aimed at; correct colouring increases the marketability of butter.

Preparation of wooden utensils on which fats of any kind are worked is a point requiring much care; the object is to get the wood in a state of perfect

cleanliness, but to still keep the pores in the wood closed. A scrubbing with warm water, a scalding, and then a few minutes' soaking under cold water will achieve this.

It has been found that a churn should never be more than half filled, and should be as near as possible to the temperature of the cream. In a churn more than half filled a cylinder of cream is said to form in the middle of the churn during rotation, causing incomplete concussion. Under such circumstances the grain takes longer to form, and unchurned cream is found amongst it.

The cover having been firmly fixed, rotation is begun ; ventilation is necessary at frequent intervals, since chemical as well as physical action takes place inside the churn and a gas is given off. This is continued until the glass begins to clear and the characteristic bumping is felt inside the churn. When the cream attains the appearance of oatmeal, breaking water is added to the amount of one quart of water to every three gallons of cream. The temperature of this water should be some few degrees below the original churning temperature ; the exact amount being only determined by observation on the farm itself, since the figures of experts vary on this point. This cooling water counteracts the heat generated by physical and some little chemical action inside the churn. For good butter-making the time given from commencing churning till this addition of breaking water is twenty-five minutes. Rotation is recommenced and continued until the grain is the size of mustard seed, when the buttermilk is drawn off through muslin, and the first washing water added at a temperature some few degrees lower than that of the breaking water. The washing water should about half fill the churn. Churning is then continued for some minutes ; this enlarges the grain slightly, hardens it, and washes it. This water is drawn off and a second washing water added, some two degrees lower than the first in temperature. The churn is then rotated until the grain is the size of wheat grain, when the water is again drawn off and a third washing water added. Usually it is not necessary to use a fourth washing, and the grain is removed from the top of

the third washing water to the butter-worker, in small quantities at a time. Free moisture is worked out by clean compression by the roller; sliding the roller along too quickly for the turn of the handle, or turning the handle of the roller too quickly for the forward movement, will destroy the texture of the butter and cause greasiness. Salt is added and worked in on the worker; a man continually removing butter from churn to worker gets to know its weight each time to an ounce, thus he can accurately gauge the amount of salt needed. A fair average, both for preserving and for flavour is three and-a-half per cent. weight, which, by the time the butter reaches the customer, generally is lowered to two and-a-half. Just the right amount of working can only be attained by experience. Neat and clean packing completes the preparation of butter for the table.

There are some helps to judging as to the quality of butter a farm is producing. The number of pounds of butter-fat (as per Gerber test) in the cream, plus sixteen per cent. overrun, should agree very nearly with the actual outturn in pounds. During the late course of instruction held for Dairy Farms Department students, every time a man made a churn of butter he weighed his cream, tested it for fat and acidity, measured all water added before the buttermilk was drawn off, tested his buttermilk for fat, weighed his salt before adding, weighed his outturn, and tested his butter for water. He then compared his results with those accepted as indicating high quality butter, and so could form a corrective criticism of his own work.

Of time and place for this most exacting part of dairy work there can be no doubt: a clean, quiet and airy corner of the dairy, in the coolness and freshness of early morning.

REARING OF CALVES ON GOVERNMENT MILITARY FARMS.

In the past it has been the custom at most military dairy farms to rear all heifer calves from both cows and buffaloes with a view to their being added to the milking herd, but the greatly increased prices of feeding stuffs in the past few years call for a revision of this policy, as the yield record of many farm-reared animals has proved that they do not repay the cost of rearing. In future, therefore, managers will only rear country-bred heifer calves from cows showing an average yield of 2,500 lb. per annum or over, and buffalo heifer calves from animals yielding 3,000 lb. per year or over. All half-bred heifer calves will be reared as formerly.

2. As regards bull calves for stud purposes at all dairies where imported bulls are not used four cow bulls will be reared annually for every 100 milch cows kept on the farm These will be selected from the best milking animals in the herd which drop male calves, and no such bulls to be reared unless the dam has an average record of 3,000 lb. or over per annum.

Buffalo stud bulls to the extent of 2 per cent. of the milking herd and from dams yielding 4,000 lb. per year or over will be reared at all farms.

3. In the past managers have often been deterred from feeding sucking calves generously, owing to the fact that on reaching maturity so many proved to be poor milkers, but if good bulls are used it may safely be assumed that the progeny of animals giving the above specified yields will repay the cost of proper rearing from birth, and in future managers of all dairies will be held responsible that the calves and young stock being reared either as stud bulls or for the milking herd are kept in first-class condition at all times, and that they are matured as early as possible.

4. All calves to be reared for stud or milking purposes must be set apart at birth and kept separate throughout their existence from those to be sold or reared for bullocks. Past experience has proved that we cannot afford under present conditions to prevent the *Gowallas* from having the calf beside the country-bred cow at milking time, but it should be the aim of the management to permit the calf to draw as little milk as possible from its dam, so that in fixing rations for sucking calves no account whatever need be taken of anything but the rations fed from the pail.

5. Not only it is essential that all calves to be reared should be kept apart from the rest of the herd, but it is also necessary that these animals should be housed and fed in pens according to their age. Thus animals under one month should be together, animals from one to three months should form another lot, from three to six months a third pen, and those from six to nine months should be housed together; after nine months they should be classed as young stock.

6. In fixing rations for young calves for rearing it must be recognised that nothing can entirely take the place of new milk for the first month, and for the first week of its existence every calf set apart for rearing shall receive not less than 6 lb. of new milk per *diem.* During this period nothing but the new milk will be given. For the next three weeks, a mixture of not less than 2 lb. new milk and 4 lb. separated milk will be fed with the addition of a small quantity of finely ground barley meal, or maize meal, or decorticated cotton seed meal, or linseed cake meal. About six ounces daily of any of these meals or a mixture of them should be added to the milk and the whole boiled together and fed in the form of gruel flavoured with either *goor* or salt.

From the age of one month no new milk need be given, but if separated milk is available it may be fed boiled with a mixture of the above meals in the form of porridge or gruel to the extent of 8 lb. of separated milk and 1½ lb. of meal per day from 1 to 3 months, and 10 lb. milk and 3 lb. meal per day from 3 to 6 months. The solid part of these rations should, of course, be gradually increased, as for instance ¾ lb. meal would be sufficient for a calf one month old, but 2 lb. could with

safety be fed at 3 months old. The full quantities of separated milk should be fed throughout the periods mentioned, but the quantities of meal given are average figures. From 6 to 9 months, the meal ration should be increased to 4 lb. fed in the same manner with 10 lb. separated milk in the form of gruel.

Where separated milk is not available, the quantities of meal to be given must be increased by 1 lb. for every 10 lb. separated milk stipulated, and the meal must be made into a fine gruel by boiling with water to which 1 oz. *goor* per animal per day is added. When separated milk is not available maize meal may not be fed.

All calves up to 9 months old should be fed three times a day, and in addition to the above rations they should get as much green and dry fodder as they will eat. It is absolutely necessary that all reared calves should be taught to drink from the pail at birth, and it is not sufficient that managers give an order that these animals are to be fed in such and such a manner or on such and such a ration. They must personally see that the correct rations are issued, that they are properly cooked and prepared, and that the animals actually partake of them.

7. Separated milk in the form of gruel must in all cases be fed fresh and sweet. Sour or curdled milk must not be fed to young calves. Meals used for gruel must be fresh and wholesome and the feeding troughs should be thoroughly cleaned out before the next feed is given. Stale gruel may be fed to adult stock. Vessels in which gruel is made and served including feeding troughs must be kept scrupulously clean.

8. In addition to proper feeding of young calves, it is of great importance that they should get proper exercise and that they should be cleanly and comfortably housed. The walls of all calf-sheds and railings of all calf-pens should be limewashed once a week and lime freely sprinkled over the floors at the same time. By proper feeding, scrupulous cleanliness, and frequent limewashing only we can keep our herds free of the skin diseases which are so prevalent in this country.

9. Calves which have been selected for rearing owing to the milk yield of their dams but which

themselves show unmistakable signs of "bad doers," and which do not thrive, should be transferred to ordinary stock on the orders of the Assistant Directors, to whose notice cases of this sort should be brought at their inspections.

10. Calves not up to the standard for rearing as stud bulls for milkers should be sold as soon as weaned and they must in all cases be kept strictly separate from the "reared animals." They should not even be allowed to graze together. It should be clearly understood that the rations set forth in this letter apply solely to calves being reared to join the farm herd.

A FEW SIMPLE TESTS FOR USE OF DAIRY FARMERS, DAIRYMEN, AND STUDENTS.

BY

R. OSBORNE, N. D. D. (I.).

In compiling this article the writer is not breaking new ground, as details of all the tests have already been published but are scattered through various works, and it is with the object of rendering them readily accessible that they are now being reproduced

Some of the tests are very well known, but are here mentioned in order to make the list as complete as possible.

Milk Testing.

1. *The Gerber Test.*—This is a cheap and simple device for determining the percentage of fat in milk, cream, buttermilk, and separated milk, and will be described first.

The articles necessary are:—

(*a*) A centrifuge (known as Gerber's Butyrometer).
(*b*) Milk pipette holding 11 c.c. ⎫
(*c*) Acid ,, ,, 10 ,, ⎪
(*d*) Alcohol ,, ,, 1 ,, ⎪ Supplied with
(*e*) Special test bottles ... ⎬ machine.
(*f*) Stoppers for test bottles ... ⎪
(*g*) Stand for test bottles ... ⎭
(*h*) Sulphuric acid of a specific gravity of 1·825.
(*i*) Amylic alcohol ,, ,, ,, ·875.

Where again referred to in this article the whole of the above will be described as "Gerber's Test."

There are several special measures to facilitate and render safe the measuring of the acid and alcohol, but it is beyond the scope of the present article to describe them.

To Test Fresh Milk.—Place the test bottles mouth uppermost in the stand.

Draw 10 c.c. of acid into the pipette, which should be provided with a safety bulb to prevent the acid reaching the mouth, and place the fore finger over the end of the pipette (a plug of cotton-wool may be placed in the mouthpiece if desired for additional safety). Allow the acid to run into the test bottle, taking care that the neck of the bottle is kept dry.

It is unnecessary to blow the last drop out of a pipette.

Similarly measure 11 c.c. of milk and add to the test bottle. Great care must be taken to avoid violent contact between the acid and milk. It is best to allow the milk to run gently down the side of the bottle.

Now add 1 c.c. of amylic alcohol.

It is essential that all liquids should be carefully and accurately measured.

The neck of the bottle must be kept dry, or there is a risk of the rubber stopper flying out.

The test bottle should now be corked with the rubber stopper which should be well pushed home.

Invert and shake the bottle until all the casein has been dissolved by the action of the acid. The mixing of the milk and acid causes a rapid rise of temperature, and it is advisable to hold a bottle with a cloth while shaking.

The bottle should now be placed in the centrifuge with the stoppered end outwards, and revolved for three minutes.

On removing the bottle, the fat will be found collected in a clear column at the thinner end of the bottle.

The column of fat, if not already there, must be brought on to the graduated scale.

This may be done by either pushing in or slightly withdrawing the stopper. It may be pointed out, however, that it is far better to arrange the position of the stopper *before* the bottle is put into the centrifuge instead of after rotating.

Get the lower end of the column of fat level with one of the long graduations on the scale, and it is then a simple matter to read the result. Each long division of the scale is equal to 1 per cent of fat in the sample, and each short line is equal to 0·1 per cent.

Greater accuracy is ensured if a pair of dividers is used for measuring the column of fat, to avoid having to raise or lower the column, as in the latter case a thin film of fat remains adhering to the glass and slight errors result.

It will be observed that the upper end of the column of fat has a curved surface called the "Meniscus." The reading should be taken to the bottom of the Meniscus

Note.—It is important that the sample of milk should be thoroughly mixed immediately before testing. This can be done by pouring from one vessel into another several times.

2. *Testing Separated Milk.*—The process of testing separated milk is the same as for whole milk, except that a special test bottle with a tapered scale known as the "Precision" test bottle is recommended as giving greater accuracy. It is also necessary to remove the bottles from the centrifuge after rotating for three minutes and place them in a water bath at about 170° Fahrenheit, rotate for another three minutes, again place in the bath, and finally rotate for one minute.

This ensures the complete separation of the fat. Results should be read in this and all cases when the contents of the test bottles are at a temperature of not less than 140° Fahrenheit.

3. *Testing Buttermilk*—This is done in the same way as separated milk.

The chief difficulty is to obtain a correct sample. The amount of breaking water added to the churn should be noted.

The whole of the buttermilk should be drawn off and weighed, and a sample taken.

The quantity of breaking water should then be taken into consideration when reading the test, and the correct reading calculated.

4. *Testing Partly Churned Milk.*—When milk has been partly churned, heat the sample in a hot water bath until the fat is melted, then thoroughly shake the sample until the whole is a perfect emulsion, and test immediately in the normal way.

5. *Testing Frozen Milk.*—When milk freezes the outer portion of the milk has a very low fat content, and the milk must be thoroughly thawed and well mixed before testing.

6. *Testing Sour Milk.*—When milk has curdled the curd may be broken up by the addition of ammonia. Take some ammonia and dilute it to the proportion of one part of ammonia to four parts of water. Add 5 c.c. of this to 100 c c. of milk. Shake gently until all the casein is dissolved. Test this mixture in the ordinary way.

The fat reading must then be increased by 1/20th to allow for the ammonia added, *i.e.*, if the fat reading is 6 per cent. the correct reading would be 6 plus (1/20 of 6) equal to 6·3 per cent.

The Lactometer.

The lactometer is an instrument which registers the specific gravity of milk. It is often advertised as an instrument which will test milk. This is incorrect, but it is frequently desirable to know the specific gravity of a given sample of milk in order to calculate the total solids.

The lactometer requires very careful handling to ensure correct results.

It must be kept scrupulously clean, as a little dust is sufficient to impair its accuracy, while if it is put away after use without careful washing the next reading is certain to be inaccurate.

The lower part of the lactometer is a weighted bulb, and the upper part a stem or rod with a scale marked thereon.

Lower the bulb slowly and carefully into the milk, which, as usual, must be well mixed previously. Care must be taken that no part of the instrument touches the vessel, and it is an advantage if the eye can be brought on a level with the surface of the milk, to ensure correct reading.

If froth is present it must be removed. Observe the figure at the surface of the milk, and this will indicate the specific gravity of the sample.

For the sake of uniformity, the lactometer is made to register the specific gravity of milk at 60° Fahrenheit, as the density of liquid varies with the temperature.

This point is important but often overlooked. It is best to have the milk as near 60° Fahrenheit as possible, but variations from this temperature can be allowed for as follows:—

For every degree of temperature above 60° Fahrenheit, add ·1 to lactometer reading and for every degree below 60° Fahrenheit, deduct ·1 from the lactometer reading.

This correction may also be rapidly made with the aid of a Richmond Scale which will be described later.

The specific gravity of genuine milk varies with different samples, dependent upon breed of animals, period of lactation, individual characteristics, and many other factors.

It may be said to range between 1·028 and 1·034, at 60° Fahrenheit, but there are exceptions even to these wide variations.

Fats reduce the specific gravity, being lighter than water.

Other solids increase the specific gravity as they are heavier than water.

It is evident then, that the use of the lactometer is limited. It is only of practical use when combined with an apparatus for testing the amount of butter fat present.

Estimation of Total Solids.

To estimate the total solids in milk it is necessary to know (1) the percentage of fat present, which can be ascertained by the Gerber Tester; and (2) the specific gravity at 60° Fahrenheit, as indicated by the lactometer.

With this data the total solids can be calculated by the following formula:—

$$\left.\begin{matrix}\text{Total}\\ \text{Solids}\end{matrix}\right\} = \frac{\text{Specific gravity}}{4} + \frac{(\text{Fats} \times 6)}{5} + \cdot 14$$

This calculation is much simplified by the use of the "Richmond Milk Scale."

The scale is constructed with a twofold object. The necessary correction of the lactometer reading when the temperature of the sample is not exactly 60° Fahrenheit may be immediately ascertained, and the percentage of total solids rapidly calculated.

The scale is constructed with a sliding slip in the centre and is used as follows:—

USE OF RICHMOND'S SCALE TO OBTAIN CORRECTED SPECIFIC GRAVITY.—At the top of the scale to the left will be found a scale marked "Temperature."

On the top edge of the movable centre slip will be found a scale marked "Lactometer Readings," ranging from 22 to 37.

To obtain the corrected specific gravity, place the lactometer reading obtained opposite the line marked 60° Fahrenheit on the temperature scale, and the corrected specific gravity will be found opposite the temperature at which the lactometer reading was taken. For example, if the actual reading was 32 at 65° Fahrenheit, place 32 opposite 60° Fahrenheit, then in line with 65° Fahrenheit will be found 32·65, which is the corrected specific gravity.

TO FIND TOTAL SOLIDS.—Now that the percentage of fat, and the correct specific gravity are known, the total solids may be found as follows:—

On the right top side of the scale is a scale of fat percentages.

On the right top of the sliding centre piece will be found an arrow.

On the bottom edge of the sliding piece is a scale of specific gravities.

Along the bottom of the scale is a scale marked "Total Solids."

Place the arrow opposite the line showing the percentage of fat present in the sample.

Find the corrected specific gravity on the lower edge of sliding scale.

The line of the specific gravity will correspond with the total solids on bottom of scale.

For example, suppose a sample of milk has a fat percentage of 3·5 and a lactometer reading 32·65,

then by placing the arrow against 3·5 on the scale marked "Fats," it will be seen that the specific gravity 32·65 is in line with 12·55 on the total solid scale. Thus 12·55 per cent represents the total solids in the sample.

It will be noticed that the scale will only calculate milk with fats less than 6 per cent.

Buffaloe's milk is usually higher in fats than this, but the solids may be calculated by dilution of sample with an equal quantity of water and then multiplying all results by 2.

OTHER MILK TESTS.

Artificial Colour in Milk.—To test for artificial colouring matter in milk, which is sometimes added to give the milk a fictitious appearance of richness, take 10 c.c. of milk and add an equal quantity of ether. Shake well and then stand until ether rises to the surface.

If the milk is uncoloured, the ether solution will be colourless, but if colouring matter is present the ether solution will be coloured.

The intensity of the colouring will give an idea of the amount of colour added.

Controls of milk known to be uncoloured should be prepared for comparison.

DETECTION OF PRESERVATIVES

The commonest preservatives used in milk and milk products in India are boric acid and other boron compounds, and formalin or formaldehyde These are active poisons, and their use even in very minute quantities should be discouraged, and it is considered that their presence should always be declared. When it is remembered that large quantities of milk are consumed by infants the importance of the subject can be realised.

Boric acid or Borax.—To detect the presence of these preservatives proceed as follows :—

"Take a small quantity of the suspected milk (15 c.c. is a handy quantity). Add a few drops of phenol-phthalein, and then allow diluted caustic soda

to drop in until the milk acquires a delicate pink tinge.

"Now add an equal quantity of a mixture made up of equal parts of glycerine and water.

"If borax or boric acid is present the pink colour disappears, but if no preservative is present no change occurs."

Formalin or Formaldehyde.—To detect the presence of this preservative pour some strong sulphuric acid into an ordinary test tube. Dilute a small quantity of milk with an equal volume of water, and run the mixture into the test tube, allowing it to run down the side.

Watch the line of junction between the two liquids. If formalin is present a violet ring is formed. If no formalin is present a greenish colour appears which quickly changes to brown.

The colour is more pronounced if a few drops of ferric chloride are added before the acid.

A RAPID TEST FOR ACIDITY OF MILK.

In creameries where milk is pasteurised before separation it is often desirable to know whether milk will stand the pasteurising temperature without curdling. It has been found that milk with an acidity of more than ·2 per cent cannot be satisfactorily pasteurised.

Take 10 c c. of the doubtful milk, add three or four drops of phenol-phthalein and then add 2 c.c. of caustic soda solution.

(The preparation of this solution is described under the head of "Test for acidity of Cream.")

If the milk remains white it is unsafe to attempt to pasteurise, and it should be separated unheated.

If the sample turns pink it contains less than ·2 per cent of acid and will stand the pasteurising heat.

It is desirable now to refer briefly to the advantages which accrue to dairy farmers and others through being able to carry out simple and inexpensive tests of dairy produce.

That advantages exist none will dispute, but it is intended to indicate some of the more important ways in which testing may be put to good account—

(I) Milk testing enables a farmer to detect unprofitable animals, more particularly when it is his aim to produce butter-fat.

(II) It has made possible the purchase of milk according to quality. This has made the modern creamery practicable.

(III) Adulteration may be detected and checked.

The only class of person to whom this is not an unmixed blessing is the dishonest milk vendor.

In this connection it may be pointed out how different classes of adulteration will be indicated. It is unfortunately far more difficult to detect and check adulteration in India than it is in countries where dairying is in a more up-to-date condition.

The principle causes of this are—

(*a*) There are no universal regulations in India controlling the sale of milk, and in consequence adulteration is very widespread

(*b*) The milk of cows and buffaloes is sold either separately or mixed, and the composition of milk is very variable even when genuine.

(*c*) There is very little information available as to the average composition of genuine milk in India, which is however far richer than in Europe and America.

(*d*) The production of milk is generally in the hands of illiterate and dishonest dealers.

As before mentioned, the existing information relating to the composition of Indian milk is meagre, but the following are figures obtained by investigators at Poona when testing a fairly large herd and may be accepted as reliable. The testing was carried out by means of the Gerber Tester, the Lactometer, and Richmond's Formula.

	Water.	Fats.	Proteids.	Sugar.	Ash
Buffaloe's milk...	81·1 to 82·2	7·6 to 8·7	4·2 to 4·3	4·7 to 5·2	·8
Solids not fat		...	9·9 to 10·4		
Total solids		...	17 7 to 18·8		

Specific Gravity at 60° Fahrenheit 1·031 to 1·0315.

	Water.	Fats.	Proteids.	Sugar.	Ash.
Cow's milk ...	84·9 to 85·8	5·3 to 5·8	3·5 to 3·8	4·4 to 4·9	·7

Solids not fat ... 8·8 to 9·3
Total solids ... 14·2 to 15·1

Specific gravity at 60° Fahrenheit 1·029 to 1·030.

It must be borne in mind that the above figures make no pretence at showing extremes in exceptional animals, but are intended to show the class of milk an average herd should produce.

When the quality of a sample of milk is suspected, first determine the percentage of fat, then find its specific gravity, and calculate solids not fat and total solids.

In drawing conclusions relating to suspected adulteration remember that—

(*a*) Fat is lighter than water.
(*b*) Milk is heavier than water.
(*c*) Skimming increases the lactometer reading.
(*d*) Skimming decreases fats and total solids, but does not materially alter the solids not fat.
(*e*) Watering decreases fats and total solids.
(*f*) Skimming and watering may give a normal lactometer reading.

The following table of examples is appended to show the conclusions which may be arrived at in dealing with suspected milk from a herd of cows :—

	A	B	C	D
Fats	5·5	3·9	4·2	4·0
Solids not fat	9·0	8·8	9·0	8·0
Total solids	14·5	12·7	13·2	12·0
Lactometer reading	1·030	1·030	1·032	1·027

A is considered to be a genuine sample ; B is probably watered and skimmed because fats are low, lactometer reading is normal, and total solids low ; C is probably skimmed because lactometer reading is high and fat is low, solids not fat being normal ; D is probably watered because everything is below normal.

CREAM TESTING.

There are two tests of cream which are of importance to the butter maker.

The first is to test the cream for butter fat and the second for acidity.

The butter fat test assists the butter maker to accurately calculate the overrun and thus eliminate losses.

The acidity helps to ensure a uniform quality and flavour of butter and also promotes exhaustive and complete churning. In both these objects the butter maker is also assisted by the tests for fat in butter milk and water in butter, both of which are mentioned else where in this article.

TESTING FOR FAT IN CREAM.

Measure 11 c c of cream with a milk pipette and pour into a small vessel. Then take 6 or 7 pipettes of water, and thoroughly mix with the cream, making sure that all the cream is washed out of the pipette. Test this mixture by the Gerber method in the same way as milk. Multiply the result by the total number of pipettes used, that is, if 6 pipettes of water were added, multiply by 7. The object of the dilution is to bring the reading within the scope of the ordinary test bottle.

Many writers advocate the weighment of cream instead of measurement, as ensuring great accuracy, and it is an undoubted fact that the specific gravity of cream decreases as the percentage of fat increases: so a distinct possibility of error is introduced by the measurement instead of weighment.

When the pipette system of dilution is carried out a small correction is necessary.

This correction is shown in the following table :--

Per cent Fat found	Correction to be added.	Per cent Fat found.	Correction to be added.
20	·12	......	......
21	·16	36	·83
22	·19	37	·90
23	·23	38	·96
24	·26	39	1·03
25	·30	40	1·09
26	·34	41	1·17
27	·38	42	1 24
28	·42	43	1·32
29	·45	44	1·40
30	·48	45	1·48
31	·54	46	1 56
32	·60	47	1·64
33	·66	48	1·72
34	·72	49	1·80
35	·77	50	1·89

If the dilution method by weighment is desired, carefully weigh 10 grammes of cream.

Then measure 60 or 70 cubic centimetres of water and proceed as above described.

This method greatly reduces the margin of error as the water can be measured in bulk in a burette instead of with a pipette, while the weighment of cream eliminates the error due to varying specific gravities.

In carrying out this test the following sources of error should be avoided :—(1) Sour cream ; (2) use of wet pipettes or flasks when first measuring out the cream ; (3) careless mixing, whereby air bubbles are drawn into the pipette along with the cream ; (4) drawing the cream too far above the mark in the pipette ; (5) loss of fat when adding water for dilution ; (6) imperfect mixing of the diluted cream ; (7) fine particles of fat left on the pipette when the diluted cream is run into the test bottle ; (8) reading the results at too low or too high a temperature.

TEST FOR ACIDITY IN CREAM.

The principle of this test is as follows :—

A few drops of phenol-phthalein are added to the cream to be tested.

This substance is colourless in the presence of an acid, but turns pink in the presence of an alkali. The change of colour indicates the point when all the acid has been neutralised and the liquid becomes alkaline. The degree of acidity is found by using an alkali of known strength and noting how much alkali is necessary to neutralise the acid in the sample. Caustic soda is the most common alkali used.

APPARATUS REQUIRED.

(*a*) A burette for measuring the caustic soda solution graduated in cubic centimetres and tenths of cubic centimetres.

(*b*) Caustic soda solution (prepared by dissolving 4·5 grammes of 98 per cent pure caustic soda with one litre of distilled water).

(*c*) Phenol-phthalein.

(*d*) Pipette holding 10 cubic centimetres.

(*e*) Small porcelain dish.
(*f*) Glass rod for stirring

METHOD.

Accurately measure 10 c.c. of cream, add three or four drops of phenol-phthalein. Note quantity of caustic soda solution in the burette.

Allow the caustic soda solution to fall from the burette drop by drop into the sample. Close watch must be kept and the sample stirred. When a permanent pink tinge is apparent. the addition of the soda solution must at once stop

Read from the burette the number of c.c. of soda solution used.

In this method 1 c.c. of caustic soda solution used indicates that ·1 per cent of acid has been neutralised, and the calculation of the result is therefore simplicity itself.

For example, if 4 c.c. of solution are used, it indicates that ·4 per cent of acid was present in the original sample, or if 5·5 c.c. are used the acidity of the sample was ·55 per cent.

TO ASCERTAIN PERCENTAGE OF WATER IN BUTTER.

For this purpose a special apparatus known as the Sorensen's Tester is recommended.

The maker's instructions for the use of the apparatus are as follows :—

"A small portion, weighing not less than 10 grammes of the butter to be tested, should be placed in one of the empty bottles provided with the apparatus and the stopper put on. Melt the butter by standing the bottle in hot water, about 140° Fahrenheit.

Place the metal dish with the glass stirrer in it upon the balance; adjust the screw at the end of the arm at the balance, so that the weight of the dish and the glass rod is exactly balanced.

Remove the dish from the balance and pour into it about 9 to 10 grammes of melted butter; shake the bottle immediately before pouring out the butter to ensure obtaining a uniform sample.

Replace the dish with the stirrer and the butter in it upon the balance and weigh it by means of the moveable weights placed upon the lever. These weights are of three sizes, the largest represents 1 gramme, the next size ·1 gramme, and the smallest ·01 gramme. For example: If the largest be in the notch marked 8, the second size in the notch marked 6, and the smallest in the notch marked 4, the weight of the butter will be 8·64 grammes.

Remove the dish with the butter and the glass rod on to the tripod and heat it by means of the spirit lamp stirring it in the meanwhile until all the water has evaporated. When the butter has ceased to foam the dish is removed and set aside to cool.

After cooling, weigh it again, including the glass rod, and deduct the second weight from the first, which will give you the amount of water which was contained in the sample and from which you may easily calculate, according to the following form, the percentage of water which it contains

For example:—

Original weight of butter	9·60 grammes.
Weight of butter after heating	8·50 ,,
Weight of moisture	1·10 ,,

1 10 × 100 ÷ 9·60 = 11·46

The butter contained 11 46 per cent. of moisture.

An ordinary chemical balance may be used for this purpose with similar dishes and rods, but the process is more lengthy and troublesome.

REVIEWS.

BULLETIN No. 78 of 1916 "SOME WILD FODDER PLANTS of THE BOMBAY PRESIDENCY." By Dr. Burns, D.SC., and Messrs. R K. Bhide, L. B. Kulkarni, L.AG., and N. M. Hammante, B.AG.

THIS bulletin will be found extremely interesting and useful, and will afford the student much instructive information. There are few men better qualified to write on this subject than Dr. Burns, and in the work under review he has given a concise and scientific record.

It is remarkable in India the ignorance that exists regarding the utility of the various wild grasses and their value for fodder. The problem of providing nutritious fodder for the maintenance of cattle kept in cities is one which is apparently growing more serious every year.

The bulletin has some excellent plates showing the various grasses which will enable the cultivator to recognise them, and from the bulletin he will gather such other information as will enable him to know the localities in which certain grasses are likely to be found. their analysis, and their utility as fodder crops.

Considering the many nutritious grasses growing in India, it is surprising to find such a poor class of hay produced and put on the market. With the knowledge available from this book, the conditions should naturally tend to improve, and with an intelligent cultivator it will be possible to grow those grasses suitable to the locality and to utilize them in the manufacture of an edible and nutritious fodder.

QUESTIONS SET AT THE LAST N. D. D. EXAMINATION.

SECTION I.—GENERAL AGRICULTURE.

Total marks, 100. *Time allowed*, 4 *hours*.

Marks.

1. Give the general situation of the 3 principal soils found in India, their chief characteristics, and what crops are best suited to each 10

2. Give the life-history of a Lucerne Plant showing how plants obtain their food from the time of fertilisation in parent plant to the time it produces seed itself. Also what useful purposes plants serve in the cycle of life 20

3. Give a brief outline of the variations of climate experienced in Quetta and Bangalore and how these affect plant and animal life. 8

4. State what you consider perfect cultivation and under what circumstances this must be modified to suit, *i e*, land in Upper Scinde, where there is practically no rainfall, and inundation canals only run for $1\frac{1}{2}$ months per annum. 20

5. Give a list of most useful fodder crops in Western India under the following heads, showing them in order of importance from a Dairy Farm point of view :— 15

(*a*) 6 Cereals.
(*b*) 6 Leguminous.
(*c*) 10 Grasses of pastures.

6. Give a rotation of fodder crops on land for which you are unable to obtain manure. Give reasons for same. 15

Marks.

7. State what fodder crops you would grow on— 12

(*a*) Wet heavy land.
(*b*) Dry sandy loam.

Section II.—General Dairying.

Total marks, 100. *Time allowed*, 4 *hours*.

Marks.

1. Give the five most promising breeds of milch cattle and two breeds of buffaloes, in India, showing their habitat and the localities for which they are best suited. 12

2. You are asked to establish a dairy farm to supply 2,000 lbs. of milk and 300 lbs. of butter per day, the former from your own stock and the latter from the creamery, say at Ahmedabad Cantonment. Give the number and breed of cows and bulls you would require with figures showing the basis, the number, and the breed of bulls you would use. Also give the strength of your herd after running for three years and what land you would acquire. 20

3. Having selected your land for above and decided on the site for your buildings, make a site plan showing the position of each of the buildings you consider necessary, and their respective distances from main and subsidiary roads and each other. 20

4. Give the advantages that may accrue to Dairy Farmers and Municipalities by using railways and motors for transport of milk and butter and how it should be treated for long distances. 12

5. State your ideas as to the present condition of breeding in India and how you would effect an improvement without losing the advantages of immunity. 12

6. State how a calf should be reared and when its rearing commences. 12

7. Give the benefits and difficulties met with in weaning Indian calves on the British system, *viz.*, weaning at birth. 12

Section III.—Agriculture and Dairy Engineering.

Possible marks, 100. *Time allowed,* 5 *hours.*

Marks.

1. Give briefly the uses that can be made of the following on a dairy farm :— 10

(*a*) Dumpy level.
(*b*) Plane table and sight vane.
(*c*) Prismatic compass.
(*d*) Gunters chain.

2. Give a cross section of second class road showing material used, and state general cost of construction per yard. 8

3. Give with approximate cost the chief items, dead stock, and miscellaneous stock, and miscellaneous stores required for the dairy mentioned in Question 2 of Section II. 10

4. Draw a ground plan of a creamery which is to turn out 2,000 lbs. of butter per day from purchased milk, showing the position of each machine. 12

5. What is the function of the safety valve on a steam boiler ; also the uses of the fly-wheel and governor on a steam engine ? 8

6. Given an engine running at 175 R. P. M. with a belt pulley of 36″ diameter, what speed would you run your shafting and what pulleys would you require to drive— 12

(*a*) Cream separator ;
(*b*) Power churn ;
(*c*) Milk pump.

The speeds and size of pulleys being—

	Dia. of pulley	R. P. M.
(*a*)	6″	... 550
(*b*)	18″	... 175
(*c*)	20″	... 60

7. What part does compression play in the internal combustion engine and what are the chief probable causes of its loss ? 10

8. What do you understand by a four cycle engine, and what is the difference between an internal combustion engine and a steam engine ? 12

Marks.

9. What are indications of—

(*a*) Too rich a mixture in oil or petrol engines. 5

(*b*) Too weak a mixture in oil or petrol engines.

10. What type of pump would you instal in the following conditions:— 13

(*a*) If you had an abundance of water with a fall of 100 feet and where you wished to raise it 500 ft., assuming that you wanted 40,000 gallons per day.

(*b*) If you wish to lift water from a well 100 ft. deep and to raise it to a tank 15 ft. above ground, assuming that you wanted 16,000 gallons per day.

(*c*) If you wish to lift water (200,000 gallons per day) from a river which is 70 ft. below your supply or distribution tank.

Section IV.—Agriculture Chemistry.

Possible marks, 100. *Time allowed*, 4 *hours*.

Marks

1. What are the chief elements needed for plant life and from whence are they obtained and how? 10

2. Give the chief chemical constituents in good soil and show three which are most easily lost. Show by what means you would prevent their exhaustion. 10

3. Give some ideal methods of dealing with the manure on a dairy farm where you have 300 acres of land around steading. 15

4. It is assumed that the following feeding stuffs are brought yearly:— 30

100,000 lbs.	Cotton seed meal		Chemical constituents attached.
100,000 „	Wheat bran		
100,000 „	Gram		
500,000 „	Kirbee or churi		

This same dairy sells 400,000 lbs. milk yearly, 50 adult cattle, and 150 calves yearly, and a stack was burnt containing 250,000 lbs. of kirbee.

Marks.

The whole of the manure, both solid and liquid, is used on the 200 acres of dairy land which is farmed intensively.

State whether the soil loses or gains from continuous cropping, showing approximately which constituents increase and which decrease if any.

5. Give the food units and cost per unit, also albuminoid ratio of the following feeding stuffs (digestible) per cent :— 20

	C. H.	Protein	Fats.	Cost per 100 lbs.		
Bran	42·0	11·9	2·5	3	0	0
Barley	65·0	8·4	1·6	3	4	0
Oats	49·2	8·8	4·3	4	8	0
Rice Dust ...	33·8	7·6	7 3	1	8	0
Linseed Meal ...	35·7	31·5	2 4	4	0	0
Cotton Seed Meal ...	21·4	37·6	9 6	3	12	0
Cotton Seed Hulls ...	33·2	0·3	1·7	0	12	0
Milk pure ..	4·5	4·3	7·5	6	4	0
Lucerne green ...	12·1	3 6	0·4	0	8	0
Hay	42·0	4·2	1·3	1	10	0
Kirbee green ...	11·6	0 6	0·3	0	6	0

6. Give the digestible nutrients required by the following :—

(*a*) Milch cow weighing 1,000 lbs. and giving 22 lbs. of milk (daily).

(*b*) Bullock at heavy work weighing 1,000 lbs.

(*c*) Growing heifer weighing 500 lbs, age about 10 months.

Make up a suitable ration for (*a*) from data given in Question No. 5.

Section V.—Accounts (N.D.D.)

Total marks, 100. *Time allowed*, 4 *hours*.

Marks.

1. (*a*) What is the principle of double entry in book-keeping? 10

(*b*) What is a waste book and a journal?

2. Below are some entries from a waste book, journalise the transactions :— 17

1916			Rs.
August	7.	Bought live stock for cash ...	300
Sept.	9.	Bought live stock from Mr. Patel ...	600
,,	18.	Sold plant and furnishing for cash ...	200
Octr.	9.	Sold plant and furnishing to the Indian Dairy Supply Company ...	100
,,	9.	Bought grain and fodder for cash ...	250
Nov.	10.	Paid to establishment	500

Chemical Constituents in 1,000 lbs.

Name of Feed.	Total Ash.	Potash K. 20.	Soda Na. 20.	Lime Ca. 0.	Magnesia Mg. 0.	Iron Oxide Pe. 203.	Sulphuric Acid So. 3.	Phospheric Acid P. 205.	Silica Si. 02.	Chlorine Ci.	Nitrogen.
Cotton seed meal ..	66·00	15·80		2·90	10·00	0 84	12·20	30·40	5 48	0 03	72·5
Wheat bran .	58·00	15·20	0·40	1·70	9 70	0 34	5 00	26 90	0·26	.	24 6
Gram	15·00	5·70	0 29	0·30	2·30	0·11	3 90	7·10	0·31	0·14	37·9
Kirbee or churi ..	34·00	10·90	6 50	4 30	2 10	0 71	3 20	3 80	0·10	0·41	5·5
Calf ..	...	2·06	...	16·46	0 79			15·35			24·64
Ox ..		2·05		21·11	0·85			18·39		..	27·45
Milk ash per cent*	.	28 71	6·67	20·27	2 80		..	29 33	..	12·22	

* Ash in 1,000 lbs. milk 7 lbs.
Nitrogen in 1,000 lbs. milk 5·76 lbs.

Marks.

3. (*a*) From the view of practical book-keeping state the use of the following books :— 14

(1) Cash Book.
(2) Petty Cash Book.
(3) Bought Book.
(4) Sales Book.
(5) Bill Book.
(6) Ledger.

(*b*) What is a profit and loss account and what is a balance sheet and the relation between the two?

(*c*) What are personal accounts, real accounts, and nominal accounts?

4. Prepare a profit and loss account for the year 1916 and balance sheet as at 31st December 1916, of a Government Farm from the following figures :—

		Rs.	A.	P.
Repairs to buildings and dead stock	...	1,899	7	9
Wages	...	10,950	6	11
Feeding expenses ...	..	759	3	6
Miscellaneous expenses ...	...	21,471	8	4
Purchase of milk and butter	...	1,07,321	15	1
Interest ..	...	2,588	13	4
Condemnations in dead stock	...	52	9	0
Depreciation on buildings ...	...	566	11	11
Depreciation on dead stock	..	140	15	0
Loss on dairy produce during transit	...	505	1	8
Amounts realised by sale of products	...	1,07,116	10	3
Other miscellaneous receipts on the farm	...	595	3	5

Value of property accounts of the farm on 31st December 1916 :— 26

Buildings	...	86,925	2	4
Live stock	...	370	0	0
Dead stock	...	33,002	13	4
Amount owed to Government	...	1,63,670	8	11
Value of stores in hand ...	...	6,819	14	7
Loss incurred in 1915 (balance debit)	...	844	10	0
Amount due to the creditors of the farm	...	3,660	12	1
Amount due to customers from deposits made for supply of dairy produce	...	6	15	0
Balance of cash in hand ...	...	8	5	0
Amount recoverable from customers	..	822	8	6

			lbs.	
5.	(*a*) Milk separated ...	..	374,360	7
	(*b*) Outturn cream ...	...	34,240	
	(*c*) Cream sold ...	...	2,500	
	(*d*) Cream churned for butter	...	31,740	
	(*e*) Butter produced ...	...	29,575	

From the above figures work out the quantity of milk it took to make 10lbs. of butter.

6. Make a ledger from the following journal showing the ledger account which will be opened and postings :—

					Folio.	Dr. Rs. A. P.	Cr. Rs. A. P.
April	1915	6	Cash	Dr.	2	600 0 0	
,,	,,	6	James Bell Capital Acct. .		1		600 0 0
,,	,,	7	Horses ...	Dr.	3	120 0 0	...
			To Cash		2	.	120 0 0
,,	,,	7	Implements	Dr.	4	90 0 0	
			To T. Smith	..	8		90 0 0
May	,,	1	Bullocks	Dr.	5	180 0 0	
			To Cash	.	2		180 0 0
,,	,,	25	C. Jones	Dr.	9	50 0 0	
			To Horses ...	..	3		50 0 0
Novr.	,,	1	Cash . .	Dr.	2	47 10 0	
			To Hay and Corn		-		47 10 0
,,	,,	1	Fee in Stuffs .	Dr.	-	15 0 0	
			To Cash . .	.	8	.	15 0
Jany.	1916	2	Cash ...	Dr.	2	50 0 0	
			To C. Jones		9	.	50 0 0
,,	,,	3	T. Smith	Dr.	8	90 0 0	
			To Cash		2		90 0 0
Feby.	,,	14	C. Jones	Dr.	9	160 0 0	
			To Bullocks		6	.	160 0 0
April	,,	5	Trade expenses (rent)	Dr.	11	120 0 0	
			To S. Williams ..		10		120 0 0
,,	,,	5	Trade expenses (taxes)	Dr.	11	13 0 0	
			To Cash ...	...	2		13 0 0
,,	,,	5	Trade expenses (wages)	Dr.	11	70 0 0	
			To Cash .	...	3	...	70 0 0
			TOTAL	..	...	1,605 10 0	1,605 10 0

SECTION VI.—VETERINARY SCIENCE.

Possible marks, 100. *Time allowed,* 4 *hours.*

Marks.

1. Describe the digestive system of the cow showing what relation it has to milk production. 20

2. State what diseases calves are most subject to and how they may be prevented. 15

3. Give a brief account of hygiene on the dairy farm. 30

4. Give six of the most serious parasitic diseases of cattle and how you would prevent your herd from being affected. 10

Marks.

5. State briefly what you know about rinderpest and how to deal with an outbreak. 17

6. Give twelve of the most important carriers of disease. 8

Section VII.—Dairy Technology.

Possible marks, 100. *Time allowed*, 4 *hours*.

Marks.

1. Give a brief outline of the method of making butter from the time the milk is separated to storage of butter. 20

2. What should be about the average of over-run in butter? The amount of salt. The loss of fat in 12
   (*a*) Separated milk.
   (*b*) Butter-milk.

3. Give a brief idea of how to test— 20
   (*a*) Cream for fat.
   (*b*) Butter for water.
   (*c*) Cream for acidity.
   (*d*) Separated milk for fat.

4. Describe the best method of sterilising milk in bottles showing chief precautions necessary to attain success. 15

5. Give in detail methods for despatching milk long distances by train. 18

6. How may the viscosity of cream be replaced after pasteurisation? 15

Section VIII.—Refrigeration.

Possible marks, 100. *Time allowed*, 4 *hours*.

Marks.

1. Explain what you know of sensible heat and latent heat? 12

2. What is the cycle of operations in a refrigerating plant on the compression system? 20

3. What do you understand by a double acting compressor, and how many suction and delivery valves are necessary for such? 15

Marks.

4. Explain the meaning of the following :— 18

Refrigerant.	Regulator.
B. T. U.	Chilled water.
Direct expansion.	Thawing tank.

5. What is the benefit of keeping brine at a certain density, and what density is most suitable? 15

6. Give a rough sectional sketch of a cold store showing insulation and arrangement for drainage. 20

Section IX.—Chemistry and Bacteriology.

Possible marks, 100. *Time allowed*, 4 *hours*.

Marks.

1. Give the two chief thermometric scales and the formula for their conversion. 15

2. State what you know of the following terms :— 18
   - (*a*) Elements.
   - (*b*) Carbo-hydrates.
   - (*c*) Albuminoids.
   - (*d*) Specific gravity.

3. To what useful purposes can the following be put on a Dairy Farm :— 20
   - (*a*) Soda.
   - (*b*) Ammonia.
   - (*c*) Lime.
   - (*d*) Nitrogen.
   - (*e*) Carbonic acid gas.

4. Give four forms of bacteria and one serious disease under each form. 16

5. State what you know of sporulation and how spores effect disinfection. 15

6. Give three bacteria which are specially advantageous to the dairy farmer. 16

Examination in the Science and Practice of Dairying.

1. The Association may hold annually in any part of India, under the Examination Board for Dairying

in India, an examination for the National Diploma in the Science and Practice of Dairying in India, the diploma to be distinguished shortly by the letters "N. D. D." (I.)

2. The examination will be held on dates and at places from time to time appointed and duly announced, usually in December.

3. A non-returnable fee of Rs. 20 will be required from each candidate.

4. Forms of entry for the examination may be obtained from "The Honorary Secretary, Dairy Education Association, 85, Survey Road, Quetta," and must be returned to him duly filled up with the entry fee of Rs. 20 on or before 15th September. No candidate may sit for the examination more than twice.

5. A candidate for the examination must, on application, present a certificate that he has spent at least two years in practical work in a dairy, or on a dairy farm run on modern lines, and approved by this Association.

6. A candidate will be required to satisfy the Examiners by means of written papers, practical work, and *vivâ voce* that he or she has—

(1) A general knowledge of the management of a dairy farm, including the rearing and feeding of dairy stock, the candidate being required to satisfy the Examiners that he or she has had a thorough training and practical experience in all the details of dairy work as pursued on a farm.

(2) A thorough acquaintance, both practical and scientific, with everything connected with the management of a dairy, and the manufacture of butter and soft cheeses.

(3) Practical skill in dairying to be tested by the making of butter and soft cheeses.

(4) Capacity for imparting instruction to others.

7. The Association reserve the right to postpone, to abandon, or in any way, or at any time, to modify an examination, and also to decline at any stage to admit any particular candidate to the examination.

SYLLABUS OF SUBJECTS FOR EXAMINATION.

I.—Practical Agriculture.

1. *Plant Biology*, as pertaining to fodder crops.
Classification—

(*a*) Thallophyta	(1) Schizophyta (Bacteria).
	(2) Diatomacæa (Siliceaus Algæ)
	(3) Fungi.
(*b*) Archegoniata	(1) Bryophyta.
	(2) Pteridophyta.
(*c*) Spermaphyta	(1) Gymnosperme.
	(2) Augiospermee.

Physiology.—Germination, nutrition, roots, osmosis, transpiration, photosynthesis, stimulation.

Diseases of Plants.—Unfavourable temperatures, light and soil, injurious animals, worms, mites, insects.

2. *Climate.*—The effects of climate on crops, animals, etc., rainfall sunshine and its work, prevailing winds, etc.

3. *The Soil*—Origin, formation, composition, classification, physical properties, soil fertility, improvement, tillage, irrigation, dry farming, intensive and extensive culture, capillarity, drainage, hygroscopic soil moisture, liming.

Fodder Crops, Gramineous Crops, etc.—Jawar or sorghums, maize, millets, teosinte, wheat or khasil, oats, guinea grass, andropogon halepense or baru, paspalum dilatatum, rhodes grass, sudan grass, andropogon aunulatus or janewa, dub or cynodon dactylon, etc., etc.

Leguminous Crops.—Lucerne, berseem, shaftal, cowpea, val, peas, gram, sann hemp, vetches, etc.

Roots.—Carrots, turnips, beets, cabbage.

Condition of Cropping.—Fodder crops to suit various soils.

Rotations.—Seed per acre, drilling or sowing, after cultivation, weeding, harvesting, stacking, catch crops for green manuring and feeding, soiling system, grazing, silage.

5. *Manuring of Fodder Crops.*—The manures of the farm, treatment of farmyard manure, liquid manure and sewage. Special manures, application of manures, suitability of manures to various crops, unexhausted values, manurial values of feeding stuffs. sewage sickness, poisonous crops.

TEXT BOOKS.

1.	Agricultural Botany by Percival	£ 0-7
2.	Dry Farming by Widstoe ...	Rs. 5
3.	Complete Farmer by McConnell	„ 4
4.	Fodder Crops of W. India by Dr. H. H. Mann ...	As. 12
5.	Journals of Dairying and Dairy Farming in India, Dairy Education Association	Rs. 5 yearly.

II.—GENERAL DAIRY FARMING.

1. *Live-Stock.*—The different *breeds* of Indian cattle and buffaloes, their origin, characteristics, comparative merits, and suitability for different districts. The chief being :—

Sahiwal, Scinde, Hansi, Kathiwar or Gir, Ongole or Nellore; also Murrah, Montgomery and Scinde, buffaloe.

Breeding—General principles, judging, selection, inheritance, variation, breeding to points, in-breeding, and out-crossing, bulls most suitable for India, imported bulls, escutcheon, dual purpose.

Care of Stock.—Raising and feeding of calves, dry stock, care of down calving animals, watering, grooming. stall feeding, grazing, exercise, records, history sheets, dehorning, segregation, removal of solid and liquid manure, prevention of hustling.

Care in Feeding.—Regular timing, correct proportion, salt in food and for licking, cleanliness of mangers.

(For chemical constituents see Section IV, Agriculture Chemistry.)

2. *Economics of Dairy Farming.*—Weeding out wasters, judicious feeding according to body weight and outturn, watching carefully losses in separated and butter milk, good store keeping, attention to utensils and machinery, methodical supervision of all branches, judicious purchase of grain and fodder, prevention of disease, good system of accounts.

3. *The Production and Disposal of Milk.*—Fore and after milk, cleanliness during milking, clean hands, udders, utensils and sheds, filteration and protection from atmosphere, rapid transport to dairy from cattle sheds, the circumstances that effect the quality and quantity of milk produced by the cows.

4. *Starting a Dairy Farm.*—Selection of site, condition of land available, irrigation, drainage possibilities, proximity to supplies, railway station, customers, etc., selection of suitable live-stock for various localities, necessary machinery, dead stock, buildings and how these may best be laid out with reference to main roads, prevailing wind, disposal of drainage, labour valuations.

Text Books.

1.	Breeding of Farm Animals by Harper	Rs. 5
2.	Dairying in Australasia by O'Callaghan	,, 15
3.	Journal of Dairying and Dairy Farming in India, Dairy Education Association ...	,, 5 yearly.

III.—Agriculture and Dairy Engineering

1. *Surveying and Levelling.*—Dumpy level and its substitutes, plane table and vane-prismatic compass, Gunter chain and their uses.

Plotting, levelling, measurements of fields, and the simpler field problems.

2. *Physics, Mechanics, and Mensuration.*—General properties of matter, universal attraction, liquids,

gases, heat, electricity, thermometers, and scales, force and work, levers, pulleys, friction, transmission gear, pressure in tanks, pumps, strength of beams, shafting, pipes, lubrication, farm measurements, ricks, acre inch, metric system, ratios, timber, grain measures and weights.

3. *Roads, Fencing, and Drainage.*—The construction and maintenance of farm roads, fences, and drains, tramlines and trolleys.

4. *Farm Buildings.*—Required on different classes of farms. Economical, convenient, and sanitary arrangement of buildings, materials, construction, ventilation, drainage, water-supply, dimensions of various buildings, cubic space per head of cattle in cowsheds, engine-rooms, stables, implement shed, cart sheds, Dutch barns, grain godowns, silo towers, manure pits and shelter, sizes, and cost of above.

5. *Prime Movers.*—Steam and oil engines, motors, dynamos, steam ploughs, motor ploughs, motor lorries, boilers, cornish, vertical and Cochrane.

6. *Agricultural Implements.*—Ploughs, cultivators, harrows, rollers, horse hoes, drilling machines, planters, sprayers, reaping machines, mowing machines, rakes, elevators, weighbridge, pumps for irrigation, machinery.

7. *Food Preparing Machinery.*—Climax silage cutters, chaff cutters, pulpers, care breakers, grain mills.

8. *Dairy Appliances and Machinery.*—Pasteurizers, separators, deliatense, mechanical and hand churns, butter workers, hominoginisers, casein plant, milk, bottlers, centrifuge for milk testing, dairy scales, Strathmos; butter platform, delivery cans and carts ghee boilers, milk pumps.

N.B.—Candidates will be expected to illustrate their answers, where possible, by intelligible sketches and diagrams, and to show a knowledge of mode of action and general principles.

Text Books.

	s.	d.
1. Introductory Physics by Gregory and Simmons	3	0

		s.	d.
2.	Applied Mechanics by Wallace Bentley	0	6
3.	Text Book of Farm Engineering by Scott	12	0
4.	Dairy and Dairy Farming by Members, D. S. U.	3	6
5.	Journal of Dairying and Dairy Farming in India by Dairy Education Association ...	Rs. 5 annually.	
6.	Agricultural Arithmetic by Newsham	,, 3	,,

IV.—Agricultural Chemistry.

1. *General Principles of Chemistry.*—Elements, compounds, mixtures, gases of the atmosphere, occurrence, properties and preparation ; Water, physical properties, chemical composition, distillation ; Symbolic notation ; Laws of chemical combination, acids and bases, salts, organic matter, carbon compounds, nitrification, oxides, common metals, combustion, putrefaction, normal solutions, insecticides, fungicides, dips and antiseptics on the farm.

2. *The Soil and Manures.*—The sampling and chemical properties of soil, composition, and valuation of manures, the atmosphere in relation to soil and manure, the chemical value of the liquid and solid manure of the dairy farm, chemical excess in soil, usar, soil, the nitrogen cycle in nature.

3 *Plants and Crops.*—Constituents of plants, composition and manurial requirements of crops, food products, produce from crops, crop residues.

4. *Feeds and Feeding.*—Constituents of foods, digestion of food, utilisation of nutrients in body, metabolism, palatability, preparation, conservation, maintenance, ration for milch-breeding, growing and other stock, unit values, albuminoid ratio, calories of foods.

5. *Milk and its Products.*—The chemical constituents of milk, the chemical changes which occur in the keeping of milk, butter, cream, and cheese, method of testing milk, cream, butter, etc., for fat, acidity, water and other solids: How adulteration may be detected in same.

Text Books.

	Rs.	A.	P.
Chemistry of Plant and Animal Life—Snyder	6	8	0
Chemistry of Farm and Dairy—Brunnich	1	0	0
Feeds and Feeding—Henry ...	7	0	0
Dairy Analysis—Droop Richmond	2	0	0

V.—Agricultural and Dairy Book-Keeping.

1. *Principles of Book-keeping.*—Single and double entry, cash books, invoices, ledgers and day books, trial balance, trading or profit and loss account, balance sheet, journals, suspense account, bad debts, establishment account, waste book, stock sheets, inventory, stock and silo books, cultivation register, depreciation, auditing, account current with bank, revenue and capital accounts, cattle register, history sheets, calf registers.

2. *Commercial Terms and Abbreviations.*—Leases, freight charges, endorsements, cross cheques, bond, contract deeds, demurrage, coupons, promissory notes, securities, remittance, bill of exchange, a/c, F.O.R., C. I. F., c/o, E. & O. E., *e.g.*, et seq., pro., P. T. O., pro. tem., q.v.

3. *Correspondence.*—Letter-writing, business, demi, reminders, customers, official.

Text Books.

Pitman's Complete Book-keeping...	£0-3-6
Answers for above	£0-2-6
Journal of Dairying and Dairy Farming in India	Rs. 5 yearly.

VI.—Veterinary Science.

1. *Animal Biology, Classification.*—Protozoa, vermes, arthopoda, mammalia (Ungulata).

Anatomy and Physiology of Cattle.—The circulatory system, the digestive system, respiratory system, nervous system, muscular system, reproductive system, the udder and mammary system.

2. *General Principles of Hygiene on Dairy Farm.*—Microbes, infection, immunity, prevention of infection, disinfection, ventilation, parasitebry, healthy temperatures, serums, vaccines, tuberculin, dentition.

3. *Disease of Cattle.*—Contagious and infectious, general diseases, therapeutics, posology, incompatibles, solubility, thermometer in diagnosis, prescriptions, classification of drugs.

TEXT BOOKS.

1.	Agriculture Zoology by Theobold ...	£0-8-6
	Or First Course Biology by Bailey and Coleman	Rs. 5-8
2.	Veterinary Physiology by Smith ...	£0-18-0
3.	Journal of Dairying and Dairy Farming, Vol. IV, Parts I and II.	
4.	Veterinary Pathology by Friedberger and Frohner, 2 Vols.	£0-18-0
5.	Veterinary Posology by Banham ...	£0-3-6
6.	Lessons in Disinfection and Sterilization by Andrews	£0-3-6

VII.—DAIRY TECHNOLOGY.

1. *Milk.*—Its physical properties and composition, normal milk, digestibility, sources of contamination, certified, inspected, pasteurised, sterilized and modified milk, advantages and disadvantages of pasteurization, homogenized milk, brine cooling and cold storage of milk, transportation of milk by rail and motor, centrifugalising milk to remove dirt, standardization, bottling and capping, delivery, skim milk and its uses as feed to calves, pigs and cattle, also as casein, lactose, dried milk and manures, microscopical appearance of milk, coloured, fishy, ropy and tainted milk, viscosity of milk, colostrum.

2. *Cream.*—Separation by gravity, hand and mechanical separators, cooling, ripening in vats with stirring apparatus, creameries, starters natural and artificial, starter vats, right degree of acidity, mixing creams of different ages, viscogen, straining cream for churning.

3. *Butter.*—Churning and washing, temperatures, timing, richness of cream, agitation, colour, temperature of breaking and washing water, ventilating frequently,

salting and working butter, composition of butter overrun.

4. *Cheese.*—Principles of its manufacture, acidity of milk, use of rennet and its substitutes, whey, ripening and storage of cheese, cream and other soft cheeses.

Text Books.	Rs.	A.	P.
Principles and Practice of Butter Making by McKay and Larsew ...	5	10	0
Dairying in Australasia by O'Callaghan...	15	0	0

VIII.—Refrigeration.

1. *Theory and Practice of Mechanical Refrigeration.*—Relation to first two laws of thermo-dynamics, definition of heat, specific heat, latent heat, calculation made with respect to heat, mechanical equivalents of heat, laws of gases, work demanded of refrigerating machine.

2. *The Compression Process or System.*—Principles of, cycle of operation obligatory in, improvements in carbonic acid machines, ammonia machines, properties of operation, various examples of modern machines.

3. *Condensers and Water-Cooling and Saving Apparatus.*—Submerged condensers, amount of cooling water required, water-cooling and saving apparatus, water-cooling towers, Heenan's water-cooler for India.

4. *Refrigeration and Cold Storage.*—The brine circulation system, the direct expansion system, the cold air blast system, piping, drums, walls and fittings for cold stores, construction and arrangements of cold stores, ventilation, air circulation, insulation in railway vans, hoisting and conveying machinery, proper method of storing and temperatures for the cold storage of dairy products.

5. *Refrigeration in Dairies.*—Examples of mechanical refrigerating installation in dairies, milk and cream coolers, ice refrigerating machine.

6. *Ice-making.*—Various methods of ice-making, the can system, the plate system, ice elevating and conveying machinery, ice-making general, brine, storing ice.

7. *The Management and Testing of Refrigerating Machinery.*—Management, oil separators, breaking

joints, piston rod packing, to change and work a carbonic acid machine, leaks, hygrometer, lighting cold stores.

8. *Cost of Working.*—Main items of expense, cost of ice-making.

TEXT BOOKS.

Questions and Answers on Refrigeration by Audel. Rs. 5-10.

Journal of Dairying and Dairy Farming in India for Cold Store.

IX.—AGRICULTURAL AND DAIRY BACTERIOLOGY.

1. *General Bacteriology.*—Relationship of bacteria to other organisms.—Method of staining, forms of bacteria, movement, reproduction, vegetative spores, classification, influence on growth by light, heat, water, oxygen, food, sterilization, pasteurization, disinfectants, antiseptics and preservatives, methods of isolation, pure cultures, media, identification, fermentation, action of enzymes, carriers of bacteria.

2. *Soil Bacteriology.*—Members and kinds of bacteria in the soil.—Action of antiseptics and heat upon the soil, nitrification, denitrification, fixation or assimilation of free nitrogen of the air, fermentative action of soils.

3. *Bacteria in Farmyard Manure.*—Breaking down of protein to ammonia, nitrites, nitrates, putrefaction, fermentation of cellulose.

4. *Bacteria in Milk and its Products.*—Enzymes and fermentation in milk, number and source of bacteria in milk, influence of temperature, methods of reducing numbers, growth of bacteria in milk, disease germs in milk, souring of milk, bacteria best suited for starters, bacteria in butter and their effects, bacteria in cheese ripening.

5. *Mould and Yeasts.*—Their uses in cheese ripening, fermented milk, the difficulties in killing spores, effects on crops.

6. *Pathogenic Bacteria, Protozoa and Fungoids.*—See under various contagious and infective diseases in Friedberger and Fröhner.

TEXT BOOK.

Agricultural Bacteriology by John Percival £0-7-6.

X.—Practical Skill in Dairy Work.

Candidates must be prepared—(1) to produce at or before the examination a satisfactory certificate of proficiency in the milking of cows, signed by a practical dairy farmer and to satisfy the examiner by a practical test if so required; (2) to churn and make into butter a measured quantity of cream; and (3) to make one cheese of each of the following soft cheeses—Camembert, Coulommier, Cream. (4) The candidate must have spent two years on a farm where dairy farming and dairying is practised on modern lines, and which is approved by this Association at time of application.

XI.—Capacity for Imparting Instruction to Others.

Candidates must also show practically that they are familiar with the management of a dairy, and are capable of imparting instruction to others.

Analysis of Examination on Candidates for National Dairy Diploma in India, held on the 16th, 18th, 19th, 20th, and 21st December 1916.

	Papers.									Practical.	Total.	Remarks.
	Section I General Agriculture.	Section II General Dairying.	Section III, Agriculture and Dairy Engineering.	Section IV. Agricultural Chemistry.	Section V, Accounts.	Section VI, Veterinary Science.	Section VII, Dairy Technology.	Section VIII, Dairy Refrigeration.	Section IX, Chemistry and Bacteriology.			
Possible marks.	100	100	100	100	100	100	100	100	100	100	1 000	
Passing marks.	50	50	50	50	50	50	50	50	50	50	650	
R. C. Woodford ..	82	87	83	82	81	86	77	95	96	84	853	Passed.
R. Osborn ..	62	78	90	82	88	87	77	89	78	86	817	,,
H. Veale .	59	83	76	69	68	69	78	70	75	74	721	,,
H. Vaughan .	66	75	76	81	76	70	70	74	72	54	714	,,

N. B.—(*a*) All who obtain 80 per cent on each subject pass "With Honours."

(*b*) Those who fail in one subject only and have the passing points in aggregate may sit for this one subject next examination.

BY THE WAY.

Motor Tractors.

The Demonstration.

The farmers who watched the Tractor Farming Demonstration were evidently impressed with the possibilities of the latest addition to the category of farm machines. With the necessity of supplementing the decreasing supply of farm labour by larger and more efficient machines they are naturally interested in one that promises so much as the tractor in the saving of time and labour. Their object in attending the demonstration was to gain a more intimate knowledge of the tractor and to judge of its merits as a business proposition. To most of them the demonstration was a revelation. To see several of the tractors in one field, all under perfect control, and leaving straight and even work behind them at the rate of from five to ten acres a day, was enough to stir the enthusiasm of the most conservative regarding the possibilities of the tractor, especially in facilitating what has always been the slowest of farm operations.

But that enthusiasm was tempered with caution. On not all Ontario farms are conditions so favourable for tractor farming as on Meadowbrook Farm, and not always would the tractors be under such skilled management as they were at the demonstration. These and other facts were carefully taken into consideration by those in attendance. All were agreed, however, that under favourable soil conditions, such as prevail in large districts in every county of Ontario, the farm tractor will occupy an important place in the future agriculture of the province.

What the Machines did.

And now as to the machines themselves. What were they like and what did they do? There were some sixteen in all, and the time was all too short for most of those present to much more than begin to size up their many points of difference, their merits and demerits. One wanted to talk and talk to those gathered all around to see what new information they might add to his own meagre supply, so foreign were these machines to any you had ever worked yourself or seen worked, no matter how wide your experience in farming may have been.

As to the various machines, there seemed to be supporters for about every make on exhibition. There was the giant tractor that turned over five furrows at once as well as a harrow cultivator and roller, and which, because of its weight and the load it was drawing, moved somewhat slowly. Against this and in striking contrast to it was a small four-cylinder machine that looked like a baby elephant compared with the other, and which fairly raced ahead, turning over two furrows at a time, but which because of its speed, said to be 2½ miles an hour, accomplished even more work than some of its larger rivals. Its record during the demonstration was an acre in 55 minutes. Between these two in size and strength were many pulling two, three, and four bottoms, and each doing consistent, satisfactory work, showing that under the conditions that prevailed the practicability of tractor farming is no longer in question.

***

Signs of Pregnancy.

(By R. A. Craig, Purdue University, in *Jersey Bulletin.*)

A subscriber asks "how to tell if his cow is in calf without waiting until the calf is born."

When a cow remains for three or four weeks after service without showing signs of heat, she is usually pregnant. However, an unimpregnated cow will sometimes refuse the male persistently, and, in exceptional cases, when pregnant she will accept the bull.

In the early periods of pregnancy (besides the absence of the periods of heat) there are other signs which are of some help in recognising this condition. These are an inclination to fatten, and a quiet or less nervous disposition.

The progressive increase in the size of the abdomen is not as noticeable in the cow as it is in the mare, because of the great size in the abdomen of some individuals, and it is not until the middle and latter periods of pregnancy that any noticeable enlargement occurs. The bulging of the abdominal walls is low down, while the flanks fall or appear somewhat hollow.

Other changes in the appearance occur in the udder, which in the latter months gradually enlarges and appears full, the wrinkles in the skin disappearing and the teats becoming more prominent. These changes occur gradually and are more noticeable in the heifer than in the milk cow. In the latter they are not especially prominent until shortly before the birth of the calf.

In a loose, pendant abdomen the movements of the calf may be felt, or noticed in the right flank as early as the fifth and sixth months of pregnancy and during the later periods. The usual method of feeling for the calf is as follows:—The hand is pressed firmly against the abdominal wall at a point about ten inches in front of the stifle and above the udder. This is repeated several times, and then a steady pressure is maintained for a time. The calf may then be felt as a hard object, which may move slightly as a result of the manipulation of the abdominal wall.

Earlier than the sixth month it is usually best to examine the womb through the walls of the rectum in order to determine whether or not a fœtus is present in it. The procedure is as follows:—The rectum is first emptied of excrement, either with the hand or by giving a warm injection. Before introducing the hand into the rectum, the finger nails should be shortened, if necessary, and vaseline smeared on the hand and forearm in order to avoid injuring the part. The hand is introduced palm downward. After passing the hand a short distance forward, the outlines of the womb can be felt through the floor of the rectum by pressing downward with the

hand, first the body and then the two branches or horns, right and left. If the young or fœtus is present in one of the horns, it can be readily recognized by the enlarged condition of the part, and, if sufficiently developed, its different parts, such as the limbs, head, etc., can be made out.

***

Cows with their third or fourth calves should be carefully observed after calving, especially if they are deep milkers, as at this period they are very apt to develop milk fever. If a cow is lying down with her head turned into her side, you should go to her and place her head in a different position. If she persists in returning it to the old position again, you may know she has milk fever.

***

Sore and Cracked Teats.

The Australian *Farm and Home* gives the following remedy:—For sore and cracked teats, wash with boric acid lotion. Boric acid is both cooling and healing, thus allaying inflammation and removing soreness promptly. It is also antiseptic in its nature, making its use a splendid thing from a sanitary point of view. Some dairymen require their milkers to wash their hands and the cows' udders in a weak solution of boric acid before each milking. The practice not only conduces to greater cleanliness, but absolutely prevents chapping and roughness of teats and udder

***

The Influence of Soil.

Two Samples of Maize.

A striking instance of the influence of soil on the quality of maize was recently observed. Two samples of maize—one grown on poor, sandy forest soil, and the other on rich river land—were forwarded to the Department by Mr. Zuill, of Lower Southgate, through the manager of the Grafton experiment farm

The forest soil had been treated with 1 cwt. of superphosphate per acre; but the crop was patchy, the stalks, as a rule, being spindly and delicate-looking with yellowish or light-green leaves. On the river land, where a summer crop of potatoes preceded the maize, the growth was vigorous from the start. Mr. Zuill reported that the maize grown on the poor land had little or no feeding value, while that produced on the rich land gave the horses "heart" immediately when fed to them.

What Analysis disclosed.

The samples of maize, upon being analysed by the chemist of the Department, were found to differ widely. The poor sample contained only 6·83 per cent. of albuminoids, while the good one contained 10·28 per cent. The average albuminoid ratio of maize grown in the district is 10·8 per cent., and very few samples go so low as 10 per cent. The very low figure in this particular case accounts for its poor feeding value.

In order to ascertain whether this deficiency could be traced to poverty of the soil in plant food, samples of the soil on which the crops were grown were obtained from Mr. Zuill, and the chemical analysis showed a substantial deficiency in the poor soil of humus, lime, potash, phosphoric acid, and nitrogen.

***

The Best Whitewash.

The whitewash is made by dissolving two pounds of ordinary glue in seven pints of water, and when all is dissolved adding six ounces of bichromate of potassium (which is kept at every cheese factory and creamery in the Dominion for keeping the composite samples) dissolved in a pint of hot water. Stir the mixture up well, and then add sufficient whiting to make it up to the usual consistency; apply with a brush in the usual manner as quickly as possible. This dries in a very short time, and, by the action of light, becomes converted into a perfectly insoluble waterproof substance, which does not wash off even with hot water, and at the same time does not give rise to mould

growth, as whitewash made up with size often does. It may be coloured to any shade by the use of a trace of any aniline dye or powdered colouring, while by the addition of a small proportion of calcic sulphite its antiseptic power is much increased.

*
* *

When Soil needs Lime.

How can we tell if a soil needs lime on account of being near or over the danger line of acidity, or for lack of lime carbonate? A test usually of practical value is the growing of clover, though this requires time. When clover grows vigorously, the soil is not in present need of lime. When clover fails to grow well on soil where it has once flourished, the probability is that lime is lacking, though this is not always the case. Heavy growth of sorrel is one symptom, but not an infallible one, of the need of lime. Another method much used is the test by blue litmus paper, which is obtainable at drug stores. When a soil is acid, it reddens blue litmus paper. The soil is moistened, if necessary, and one end of a strip of the blue paper is pressed against it and allowed to remain in contact for some minutes. If it soon reddens appreciably, the usual, but not necessary, indication is need of lime. It is thus seen that we have no simple, quick, reliable method for telling when a soil needs lime.—Prof. L. L. Van Slyke, in the *American Agriculturist.*

*
* *

What Cows take from the Soil.

As a rule, the soil elements required for the growth of plants are abundantly present in the soil, except nitrogen, phosphorus, and potassium. These are the principal elements with which the farmer is concerned in feeding his crops. Therefore, fertilizing the land, or feeding the crop, calls for a study of the nitrogen, phosphorus, and potassium taken up by the crop and removed from the soil.

Dry corn grain, or kernels when removed from the cob, contains of water about 10 per cent., of

nitrogen 1·82 per cent., of phosphorus 0·7 per cent., of potassium 0·4 per cent. This means that, in 100 pounds of crib-cured shelled corn of average quality, there are of water 10 pounds, nitrogen 1·82 pounds, phosphorus 0·7 of one pound, potassium 0·4 of one pound.

The cornstalks, when thoroughly field-cured, or dried as dry as hay, contains of water about 40 per cent., nitrogen 1·76 per cent., phosphorus 0·54 per cent., potassium 0·89 per cent. This means that 100 pounds of field-cured corn fodder of good average quality contain of water 40 pounds, nitrogen 1·76 pounds, phosphorus 0·54 of one pound, potassium 0·89 of one pound.

***

Feed the Crop and it will feed you.

Even that old-fashioned farmer who says he "can't afford to buy fertilisers," has to admit that each crop produced removes from the soil that amount of plant food required to build up the structure of the plants grown, and as there must be a limit to the quantity of available food in any soil, it follows that the land will become exhausted unless assisted by the application of the right kind of fertiliser. It is not rational to apply an incomplete manure like bonedust to land deficient in potash, for as bone manures contain no potash, it is useless to expect the addition of a manure containing only phosphoric acid and nitrogen to increase the growth of a crop requiring potash on a soil already depleted of the latter element. It is equally wrong to apply a fertilser containing only phosphoric acid and potash to a crop requiring nitrogen—for instance, a sorghum crop grown for green feed wants plenty of nitrogen to promote a heavy growth of flag, and old worn-out soil will not produce the required luxuriant crop without the assistance of the right kind of fertiliser. There is no excuse for crop failure if farmers persist in standing in their own right by refusing to recognise that it pays to spend a few shillings per acre on a good fertiliser specially blended to suit the crop he intends growing.

Increasing the Milk Yield.

The *Farmer and Stockbreeder* says:—"At the present time there is a strong demand that farmers should do their utmost to increase the production of food. It is interesting, therefore, to see what can be done in the way of producing more milk and butter. The first point we should remember in this connection is, that the greater the milk yield of our cows the cheaper will the milk be produced per gallon. We can do very little by feeding. If we have a splendid cow we can feed her so that she will do her best; if we have a poor cow we can do the same. But no amount of food will make a poor cow give a good yield. If we try to force her she may give a little more milk, but the extra milk will probably not pay for the extra food required. We might be able to increase the number of cows giving milk, and each must think that out for himself. The recognised way of increasing the milk yield of a herd is by selective breeding, but that is a process which requires years of careful attention to achieve a measurable improvement. By employing bulls of a good milking strain and mating them with selected cows which have given good yields of milk, something can be done. The importance of weighing the milk from each cow and regularly recording it should be recognised. It is in time of stress usually that the greatest progress is made. The progress made in Sweden by the work of the milk-recording societies is shown in the following calculated annual yields per cow:—1870, 2,600 lbs.; 1880, 3,700lbs.; 1903, 4,200lbs.; 1913, 4,730lbs. The champion American Holstein-Friesian cow, Tilly Alcatra, gave 30,451lbs. of milk, so there is plenty of room for improvement in the average cow still."

***

Milk may become tainted from—(1) Absorbing bad odours. (2) The dust and dirt that may get into the milk during and after milking. (3) Rusty and unclean utensils. (4) Cows drinking impure water.

***

Life and Nitrification in the Soil.

There are two great processes going on continually in the soil which are known to be due to the activeness

of bacteria: (*a*) The conversion of ammonia and other compounds containing nitrogen, derived from decaying organic matter and nitrogenous fertilisers into nitrates, the only form in which, so far as we know, plants can utilise the nitrogen; (*b*) the utilisation of free nitrogen of the atmosphere by leguminous plants. Both these processes are greatly facilitated by the presence in the soil of a sufficiency of lime.

The soil is not an inert mass of material containing certain mineral substances which plants utilise. It is full of living organisms. Besides the numerous insects, worms, etc., it contains myriads of low organisms not visible to the naked eye, but capable of examination by the aid of the microscope. They are known as bacteria or micro-organisms, and are so minute that a grain of soil may contain many thousands, increasing and propagating under favourable conditions with incredible rapidity. They exist in the soil chiefly in the upper layer. A pinch of soil may contain from several thousands to several millions; loamy soils and soils containing much organic matter contain most; sandy soils contain least. The number decreases gradually from the surface soil downwards till about 3 feet, where very few or none are present. Each different kind of bacterium performs its own useful purpose in Nature, but in the interest of economical cultivation, it would appear that the growth of some of them has to be encouraged and the development of others to be checked. The subject, however, is not at present clearly understood, and has to be further investigated; for us the practical knowledge is that organic matter, by increasing the supply of humus in the soil, favours the rapid growth of the kind of bacteria that converts organic ammonia into nitrates, suitable for assimilation by the crops. We have, by the ploughing under of green crops and other suitable means, a sufficient supply of humus.—*Mark Lane Express.*

***

Analysis of Straw.

Numerous analyses have been made by chemists of straw, from which it has been ascertained that it may be reckoned to contain on an average about 11lbs. of

nitrogen in the ton. There is a slight difference in the straw of the different cereals; oat straw is the richest in nitrogen, containing nearly 16lbs. to the ton; barley straw comes next with about 13lbs.; and wheat straw is the poorest, about 10½lbs. to the ton.

The mineral constituents are also variable as shown by the following table taken from Ackmann's "Manures and Manuring":—

	Pounds per ton.		
	Potash.	Phosphoric Acid.	Lime.
Wheat (winter)	18·61	5·05	7·18
Wheat (summer)	25·76	6·47	7·12
Barley	26·83	5·75	8·73
Oats	26·22	4·17	9·12

It may be noted from the foregoing particulars that a ton of oat straw returns to the soil about as much nitrogen as is contained in 1 cwt. of nitrate of soda, but of course not in the same quickly-acting condition.

The large quantity of potash taken by the straw from the soil should be observed, and on the other hand the small amount of phosphoric acid. The explanation of the insignificant quantity of phosphoric acid in the straw is that this ingredient passes from the straw to the grain as the plant reaches maturity; thus the grain of a wheat crop (30 bushels) contains 16lbs. of phosphoric acid, and the straw of the crop only 4lbs.—*The Dairy.*

***

Rotation of Crops.

Rotation, as used in agricultural writings, means a circle or cycle, including two or three or four different exhaustive crops, each grown for one year with one recuperative crop sometimes grown two years in the rotation. Sometimes one particular crop, perhaps maize or potatoes or tobacco, seems to pay best under the given circumstances. Then why not grow that best-paying crop year after year continuously? The scientific reasons for rotation are in part as follow:—

Rotation equalises Soil Exhaustion.

All plants must have the ten "essential elements," and three of the ten or their compounds—nitrogen,

phosphoric acid, and potash—are liable to "run short," as we have seen. Crops vary considerably as to the relative amounts of each of the three that they require. For example, tobacco requires about nine times as much potash as wheat and its straw per ton, and thirteen times as much per acre for a good crop. Potash is therefore sometimes called the "predominant requirement" of tobacco, and nitrogen of wheat and maize. Now each plant or crop must have its proper proportion of each element, just as brick mortar must have the right proportion of lime, sand, and water, or you cannot lay brick perfectly. Tobacco is known as "a potash crop." Wheat and maize are known as "nitrogen crops."

Experience confirms Science.

From what has been said it seems clear that if tobacco is grown continuously on the same lands, then potash, its "predominant requirement," will soon run short. Now let us see if experience agrees with the teachings of science.

For example—tobacco and potash. The thin hill lands of Brown County, Ohio, and a few nearby counties, grow a fine grade of tobacco, and the farmers would be glad to grow that crop year after year. But they cannot. If they clear the hillsides and burn the brush and rubbish, they get one fine crop of tobacco, but if they try it again the next year, they get a much poorer crop, and the third year practically no crop; yet they can get a fine wheat crop after the first crop of tobacco and even after the second attempt. Why? Because the natural potash of the clayey soil, increased by the potash from the ashes of burned brush, etc., gave enough of its "predominant requirement," potash, for one fine crop of tobacco, but not for two or three. But the careful tillage of the tobacco, with the shading of the big leaves, helped the bacteria to decompose the humus of the soil and make its inert nitrogen available to supply the "predominant requirement" of the wheat, *viz.*, nitrogen. And so a good crop of wheat ought to and does follow a good crop of tobacco. Then by sowing clover in the wheat and applying some added potash, the clover roots bring up more potash from the deep clay,

and nitrogen from the air, and the farmers are ready, after a full year with clover, for another year with tobacco and with wheat and clover again in rotation. How simple, when we learn the reason why! In like manner potatoes and cabbages, both strong potash users, both good developers of available nitrogen, are both good crops to prepare for wheat followed by clover. This explains the strongest reason for rotation —it equalises the exhaustion of plant food.

Rotation checks Weeds and Insects and Fungous Pests.

As to weeds, it is perfectly plain that at least one "hoed crop" in each rotation, if the cultivation is as thorough as it should be, will destroy millions upon millions of weed seeds just as they are germinating. As to insects: Wheat after wheat is apt to breed Hessian flies in destructive numbers because wheat is their natural food. The first crop develops them in small but not destructive numbers. If a second crop of wheat is attempted on the same land, the prolific flies are likely to prove, like Mrs. Partington's feelings, "too many" for it. But if clover follows the wheat they perish, for they cannot eat (or suck) the clover. In like manner potatoes after potatoes are likely to be destroyed by bugs or blight; and maize after maize is likely to bring in the maize worm or other maize pests or diseases. But a proper rotation largely prevents these troubles.

Shallow and Deep Feeding Plants, and Rotation.

A rotation is best because some plants are shallow feeders and some are deep feeders. Wheat, and especially the clovers, are deep feeders. Maize and most of the grasses are rather shallow feeders. A proper rotation will draw evenly on the whole three feet deep and not merely on the top six or eight inches of the soil.

Rotation distributes the Farm Work.

Maize was formerly grown almost exclusively in parts of Illinois, and spring wheat in the Dakotas, and the work was "bunched" into a few months of each

year. But crops in a well-planned rotation, fed to cows, cattle, or sheep and lambs all winter, give steady remunerative work the year round.

Rotation increases available Plant Food.

This is especially true where clover (a recuperative crop) is included in the rotation, and it should never fail to be included.

The Rothamsted Experiments.

In the famous Rothamsted (England) experiments, lasting thirty-two years, with and of the usual English rotations—namely "roots" (for maize will not ripen there), barley, clover, and wheat—each one year, and with all the crops removed and no manure added, and therefore with no plant food used except what was developed from the "potential" plant food in the soil, under these conditions barley grown continuously averaged only 18 bushels and wheat only 12 bushels per acre; but grown in the relation with clover, described above, the barley gave 32 bushels per acre and the wheat 26 bushels per acre. That is, the rotation developed more than twice as much available plant food for the wheat, and nearly twice as much for the barley, as did the continuous cropping with each respectively. Good for rotation! That is, facts support the teachings of science. The reasons why clover is so valuable in a rotation have been quite fully explained. The above facts as to Rothamsted are given and commented on by Professor Vivian in his *Soil Fertility.*

***

Moisture Control of Butter.

(By H. F. Campbell.)

It is no longer a question whether or not a creamery can do business safely without making moisture tests of its product. In almost every issue of the creamery and dairy papers one sees accounts of some creamery being fined by the Government for having too much moisture in its butter. It is not only unsafe from this point of view, but more so from the business side. If there were absolutely no Government restrictions on the percentage

of moisture in butter, it would be folly for any creamery to attempt to do business without taking moisture tests. With competition and prices as they are to-day, the buttermaker must be sure to get his overrun right, and this means that his moisture in the butter must be right, for moisture is the largest factor affecting overrun with which the buttermaker has to deal.

The moisture in a piece of butter cannot be told by merely looking at the sample, but to know exactly where the overrun is coming from and to prevent loss from low moisture, the butter from each churning must be tested for moisture content. By taking accurate moisture tests the buttermaker will be led to control more carefully his churning temperature and the amount of water in the churn while the butter is being worked. These two factors are of the greatest importance in the proper control of moisture in butter.

It is not necessary to argue the case of moisture tests with most buttermakers, for most of them are now making such tests. The fact that the buttermaker is making tests of every churning, however, does not mean that he can accurately control the moisture, which is the one great demand on all good buttermakers. The question of quality and body of butter can be well taken care of by most buttermakers. But day in and day out he must keep a careful watch that his moisture does not exceed 15·9 per cent., and that his overrun is what it should be. This one problem of moisture control causes the buttermaker more worry than any other, if he is conscientious and does not try to slip out high moisture butter, hoping that he will not be caught this time. I have seen buttermakers hold churnings several days at low temperatures, pack butter in unparaffined tubs, print tub butter and re-work butter which was held at low temperatures, trying to reduce the moisture content, but with little or no success. It is certainly a fact that moisture once properly incorporated in butter cannot be easily reduced.

It is in the working of the butter that the buttermaker must be especially careful. It is not safe to try and judge by appearance the proper amount of working of butter in the incorporation of moisture. Experience is a great factor in buttermaking, but I do not believe

that anyone can get accurate results by working his butter as long as he thinks necessary and taking it out of the churn and then taking his moisture test afterwards. A buttermaker whose moisture tests are continually varying over five per cent. is not using the proper care in his work. It is not safe to work butter a certain number of revolutions ; test it, and then add what water you think necessary. It is too easy to mistake the amount of free water in the churn, and it is hard to guess at the proper amount to add. Often three or four tests have to be made. Perhaps the last one has overshot the mark.

The following method of controlling moisture in butter has been successfully used, and is a safe and reliable way. To operate this method the pounds of butter-fat in each churning must be known and the amount of butter expected figured. After the butter is churned, washed, and well drained, it is worked from two or four revolutions and drained well again. The salt is added and the butter worked until all free water in the churn is taken up and incorporated in the butter. The moisture test is then applied.

***

Agriculture for Beginners.

(By Dr. W. L. Chamberlain.)

Phosphorus.

In most agricultural writings phosphorus is usually mentioned and rated as "phosphoric acid." This last is a compound of phosphorus, oxygen, and hydrogen, and is the form in which it is used by plants in fertilisers and manures, and the form and name by which its percentages are, by law, printed on all fertiliser sacks that claim to contain it. Phosphorus itself is a whitish and very inflammable substance, which is caused to take fire and burn by the heat generated by a little friction against a rough substance, and hence it was long used (and still to some extent) on the tips or ends of friction matches, where it may be seenand touched. The word "phosphorus" comes from the Greek, and literally means "light producing." "Lucifer" from the Latin means

exactly the same, and hence the name "lucifer matches." Phosphoric acid composes 20 to 24 per cent. of dry animal bone, and this amount all animals and men must get from their food, and this the plants that the animals eat must therefore get from the soil; and the plants and animals that men eat must get it directly or indirectly from the soil. The young of all sucking animals must get the phosphorus for the first few months of the growth of their bones, teeth, etc., from their mother's milk, their only food, and therefore these mothers must have phosphorus in their feed to give phosphorus to their milk. The office of this element in plant-growth is, in part, to hasten maturity, improve the grain of cereals, and especially to help form the bran. As already implied its office in animal life, together with lime, is to form the bones and bony or horny parts.

Potash.

This is a compound of the true "elements" potassium and oxygen. The name potash (the form in which it occurs most in nature and in commerce) is used by nearly all agricultural writers instead of the pure "elements" potassium, and is also used on fertiliser sacks because the percentage of "potash" and not of potassium is required by the laws of nearly or quite all of the States. Hence the term "potash" will be used in these articles to save confusion. Potash was formerly made by leaching wood ashes and boiling the lye in "pot-ash" kettles until a whitish solid or granular substance resulted which was therefore called "pot"-ash. "Caustic" potash may be got at the druggists. It looks like white chalk, blackboard crayons, and is used to "burn" the coming horns on calves and prevent their growth, for "caustic" means capable of burning something. Its full office in plant-growth seems not to be so clearly known, but it certainly is the predominant valuable part of the ash of woody plants, and it forms a part of the acids of most fruits and is supposed to add brightness to the colour, especially of apples. Tobacco requires very much potash, and potatoes and cabbages use somewhat less than tobacco, but more than most other plants, and hence are known as "potash crops." Its purchase in fertilisers is usually wise for sandy or mucky soils, but

is seldom wise for clayey soils, which are usually rich in potash.

The present source of nearly all of our commercial potash is the vast deposits of crude "potash salts" near Stassfurt, Germany, enough to supply the wants of agriculture and commerce for centuries. The refined and re-crystallised sulphate and muriate of potash look much like common coarse salt, and each contains about 50 per cent. of "actual" potash in a condition almost as soluble as common salt. The cost of these three most important kinds of plant food in commercial fertilisers, in normal times, is about as follows:—Nitrogen, rated as ammonia, 1*s.* 3*d.* per lb.; phosphoric acid, 2½*d.* per lb.; potash (actual), 2½*d.* per lb. But the European war has greatly advanced the price of the German potash salts and sent up the price of phosphoric acid considerably

* * *

Oil Engines and Pumping Plants.

In purchasing an engine, look for simplicity of construction, as the machine with the least number of working parts is the easiest to keep clean and least liable to get out of order. An engine of this type will use any class of paraffin, from the worst to the best. It is not necessary to have an oil pump, a charge measurer, or timing valves, etc., on an oil engine to work satisfactorily; in fact, one that does away with these appliances always gives more satisfaction to the owner than one of complicated construction.

One of the chief troubles of oil engines is overheating of the vaporiser and cylinder. To overcome this trouble in the cylinder, do away with the water tank. That is where the trouble lies, for the water in the water-tank becomes overheated and consequently overheats the cylinder. Screw a small tap in the main leading from the pump, and connect a small hose from it to the bottom of the cylinder. It is also necessary to put a hose on the top outlet of the water-jacket. By this means you can always keep the cylinder at the required temperature, which should not be more than 90 degrees to give the best results. If the heat exceeds 150 degrees the engine stops working. Every owner

should know the workings of an oil engine if he wishes to be successful with it. The principle is the same in them all. There must be a certain heat before it is in a condition to start work. When the piston is on the out-stroke there is a vacuum in the cylinder. Then paraffin and air rush through the heated vaporiser causing paraffin to be transformed into a smoky gas. Passing into the cylinder this becomes mixed with air, and forms a high explosive. The return stroke of the piston compresses this charge, which is fired at the back of the cylinder, causing the piston to move with terrific force on the out-stroke. On the return stroke the burnt gases escape through the exhaust valve into the open air; thus there is only one working stroke in every two revolutions of the engine. If too much paraffin enters the engine it will soon cease working. Should this happen, reduce the compression on the springs of the oil pump, or, if your engine is not provided with one, slacken the spring on the air valve. It is much better to have the mixture a trifle poor than too rich, as it will explode better and quicker if the gas is poor.

The term "horse-power of an engine" puzzles a good many people. An engine which can raise 33,000 lbs. one foot high in one minute is called "one-horse-power." To find out how much water an engine can pump to a given height the rule is as follows: Supposing the height you wish to raise the water to be 100 feet, deduct 20 per cent. from the power of the engine to allow for friction of pulleys, pumps, piping, etc., then divide the remainder by 100, and it will give you the weight of water that the engine is capable of raising. Taking a five-horse-power engine, for instance; allow one-fifth for friction, and there is left for work, four-horse-power of 33,000 lbs. each, equal 132,000 feet pounds. This, divided by 100 and again by 10 to bring the pounds to gallons, gives 132 gallons per minute.

Purchase a pump that is easy to take to pieces without removing all the skin from your knuckles in the operation, and, if possible, have a double-action pump, as it gives a continuous flow of water. Force pumps are the only kind that can be satisfactorily used in the hills. This pump should also have a large air vessel,

as this greatly relieves the strain on it and the belting, etc. It is not necessary to have the pump close to the water's edge, for 50 feet or even 100 feet horizontally will not greatly affect its working. It only takes a little longer to exhaust the air from the pipe. Do not have the pump more than 27 feet from the bottom of your well or dam. A pump will draw from a depth of 32 feet, but it is not safe to try more than 27 feet for safe working.

A great mistake is made in getting pipes that are too small for the pump. A safe rule is 2-inch main for 1,500 gallons per hour, $2\frac{1}{2}$-inch for 2,500 gallons, 3-inch main 3,500 gallons. Another mistake is made in supposing that a tank of large diameter will give a greater pressure on the main than a small one. If the depth of both tanks is the same there will be no difference in the pressure in the mains. With two mains, one 2-inch in diameter and the other $\frac{1}{2}$-inch in diameter, coming from the same tank, the pressure at the lower end of the mains will be equal.

All correspondence regarding the Journal, advertisements, etc., should be sent to the Hon. Secretary, Dairy Education Association, No. 12, Victoria Road, Poona.

This Journal is issued Quarterly, in October, January, April, July.

RATES OF SUBSCRIPTION.

Membership to Association	...	Rs. 5-0-0
Annual subscription to the Journal	...	,, 4-0-0
Single Copy, including postage	...	Re. 1-0-0

ADVERTISEMENTS.

			Annual.	One issue.
Full	page	...	Rs. 20-0-0	Rs. 6-0-0
Half	,,	...	,, 13-8-0	,, 4-0-0
Quarter	,,	...	,, 7-0-0	,, 2-0-0
6 Lines	...	...	,, 3-0-0	Re. 1-0-0

SUB-COMMITTEE FOR INDIA.

CHAIRMAN.

Dr. HAROLD MANN, D.SC., M.SC., F.I.C., K. H. Gold Medallist,
Principal, Agricultural College, Poona, and Agricultural Chemist to Government of Bombay.

MEMBERS.

WILLIAM SMITH, Esq.,
Assistant Director of Government Dairy Farms, Southern Circle, Poona.

D. CLOUSTON, Esq., M.A., B.SC.,
Deputy Director of Agriculture, Nagpur.

H. J. RIDDICK, Esq.,
Manager, Government Dairy Farms, 4th (Quetta) Division.

EDWD. KEVENTER, Esq.,
Proprietor of Dairy Farms, Aligarh, Simla, etc.

W. REEVES, Esq.,
Indian Dairy Supply Coy., Ltd., Bombay, Nadiad, etc.

R. OSBORNE, Esq.,
Manager, Government Central Creamery, Ahmedabad.

G H. FROST, Esq. (Hon. Secy.),
Government Military Dairies, Southern Circle, Poona.

DAIRY EDUCATION ASSOCIATION.

_______________191

THE HON. SECRETARY,

DAIRY EDUCATION ASSOCIATION,

(INDIAN BRANCH),

POONA.

Dear Sir,

I wish to become a member of the above Association, and if elected agree to promote the welfare of the Association to the best of my ability and to remain liable for my subscription until I shall notify the Hon. Secretary of my resignation. On receipt of your letter advising me of my enrolment as a member, I will forward the subscription of Rs. 5 to the Hon. Secretary (Mr. G. H. Frost, Government Military Dairy Farms, Poona), and yearly on October 1st, or otherwise accept the 1st issue of the Journal by V.-P. P.

Dairy School or Schools attended and length of time of instruction.

....

....

Dairying Certificate, Diplomas, etc.

....

....

(Signed)..

Mr., Mrs., or Miss, etc.

Permanent Address...

....

VOL. IV, PART III. QUARTERLY. APRIL, 1917.

THE JOURNAL OF DAIRYING

AND

DAIRY FARMING IN INDIA

DAIRY EDUCATION ASSOCIATION

D. E. A.

Printed by Thacker, Spink & Company, 6, Mangoe Lane, Calcutta, and
Published for the Committee, Dairy Education Association in India.

CONTENTS

THE

JOURNAL OF DAIRYING

and

Dairy Farming in India.

VOL. IV.—PART 3.] QUARTERLY. [APRIL, 1917.

EDITORIAL.

THE annual meeting of our parent Association at Home was held on December 7th, 1916, at the Council Room of the British Dairy Farmers' Association, Mr. F. J. Lloyd presiding, and among those present being Miss A. Mathews, Miss F. L. Patrick, Mrs. Bulstrode, Miss A. Crawford, Messrs. C. W. Walker-Tisdale, J. W. Tayleur, G. P. Roberts, E. Hatfield, Staff-Sergeant J. Chesterman, R.A.M.C., and Mr. W. E. Manchester (Hony. Secy.).

The accounts for the year show that after meeting all outstanding liabilities and deducting subscriptions paid in advance, an amount of £8 0*s*. 7*d*. remains to the credit of the Association's funds.

The Indian Branch have suggested the payment of an annual levy of 1*s*. instead of 2*s*. 6*d*. per member, and

have remitted a sum of £5 in respect of 100 members. The Council are of opinion that this arrangement should be acceded to, and they desire to express their appreciation of the continued interest of their Indian fellow members in the parent Association.

The majority of the male members are now serving with the colours, and a number of lady members have now relinquished dairy work temporarily to take up Red Cross and other work connected with the war. It is hoped that these will renew their membership when normal conditions return.

* * *

INDIAN NOTES.

A FEW of our members refused to take delivery of Vol. IV, Part I, of the Journal, which was sent V.-P. P. in accordance with the decision of the majority of our members.

It is to be regretted that these members did not intimate to the Secretary their decision to resign membership of the Association. This would have saved expenditure on postage and commission charges.

* * *

MR. G. H. FROST, our Honorary Secretary, has recently been appointed Assistant Director of Dairy Farms, Mesopotamia, with temporary rank of Captain. He will, in the near future, be leaving India to take up his new appointment.

Captain Frost has been Honorary Secretary of the Association and Editor of the Journal since the branch was started in India, and the present satisfactory state of the Association is mainly due to his efforts.

Practically the whole business of the Association has rested upon his shoulders, and his energy, tact, and determination have overcome many obstacles.

The Committee and members take this opportunity to congratulate him on his appointment and desire to convey to him through the medium of the Journal their best wishes for his success in the arduous duties he is taking up.

Captain Frost will continue to assist in the Association work and will continue to contribute articles to the Journal. This we are glad to note, as the articles contributed by him in the past have been much appreciated by our members.

Mr. H. J. Riddick, No. 85, Survey Road, Quetta, will take over the post of Honorary Secretary during the absence of Mr. Frost.

All communications, etc., in connection with the Association may kindly be addressed to him.

***

THE Committee congratulates the four members—Messrs. Osborn, Woodford, Veale, Vaughan—on securing the National Dairy Diploma of India.

Many of the papers were extremely well answered, and showed a good insight into theoretical and practical dairy work in all its branches.

The Committee hopes a large number of members will come forward for the next examination.

***

WE are glad to notice that the Bombay Government are still pressing ahead in dairy matters. The discussion on their budget estimate indicates activity in this direction. Two breeding farms for milch cattle are to be started, *viz.*, one in Karachi to preserve and improve the Karachi or Sind breed of cattle, and another at Sholapur. In addition to the above we see that some definite action has been taken on the Committee Report regarding the "Improvement of Milk Supply to Cities" in the shape of a grant to help to improve the Poona supply.

This is most encouraging to those interested in the future of Dairying Industry in India.

***

IT is proposed to hold the Annual Examination for the National Dairy Diploma (India) during December. The dates of the examination will be published later.

In order to enable the Committee to make arrangements for intending candidates to sit for this examination, they are advised to send in their names to the Honorary Secretary as early as possible.

AIRY FARM MANAGEMENT IN INDIA.

BY

MEOLICAN.

(*Continued from page* 195.)

Refrigeration.

This science is undoubtedly an important one for India, where the high climatic temperature has been the chief cause of the non-development of many lucrative trades. This is particularly so in the dairy trade. Many ice plants have been installed during the last six years, but there are few institutions where cold stores are erected. There are fewer institutions where refrigeration is used in other ways such as for brine, cooling various liquids as beer, milk, etc.

It is certain that no self-respecting dairy institution of any size can afford to be without these refrigerating plants, and where they are not used very inferior and unreliable products may be expected. Milk cannot be kept in India for many hours unless cooled by some artificial means. Ice may of course be used for small quantities, but not where large amounts are handled.

In deciding the need of refrigeration in dairies, the following points are considered :—

1. Does the trade necessitate milk being kept over for a long period ?
2. Whether milk is to be despatched long distances.
3. Whether large quantities of butter are to be made.
4. Is it necessary to store butter in large quantities?

5. Whether ice can be used satisfactorily, and whether its price is reasonable.

6. Whether the turnover in products is sufficient to warrant the installation.

The Government farms in India are mostly fitted with these plants, even where the turnover does not warrant it, because it has been determined that the troops shall get the best produce possible, irrespective of whether these institutions are profitable or not.

Where it is difficult to decide whether purchased ice or refrigerating plant is best, the following advantages and disadvantages may be of use.

Advantages of Refrigeration over Ice.—1. Ice is difficult to manipulate, whereas for milk cooling, cream ripening, chilling water, etc., cooling medium in pipes is much more convenient.

2. Cost of running is regular and is cheaper where ice is over Rs. 25 a ton.

3. Can be used with better control as regards temperature.

4. Produce can be stored drier with less risk of moulds, etc.

5. Cleaner than ice for handling with less wastage.

Disadvantages of Refrigerator.—1. Greater initial expenses.

2. Risks of breakdowns and accidents.

3. Constant running of machinery.

4. Greater expenditure of water.

5. Cannot be made economical for very small concerns.

Assuming that it is decided to instal a refrigerator it is necessary to consider what machine is best (*a*) as regards maker, (*b*) as regards size, (*c*) ease of manipulation.

(*a*) There are several very good machines on the markets, but Government dairies have decided that I. & E. Hall's ammonia plant is the most suitable for hot stations and the CO_2 machine for cooler places in India.

(*b*) The makers or their agents are always ready to assist in this, and, if given the amount and nature of work to be done and the temperature of condensing water, they will state exactly what is needed. It is, however,

fairly simple for a dairy manager to make these calculations himself, if he has studied the subject sufficiently. For instance if he wishes to cool 2,000 lbs. of milk daily he can tell to what degree his water will cool it, say 70°F., and that if he wishes further to cool it to 40°F. he has ($\cdot 90 \times 30 \times 2,000$) or 54,000 B. T. U. to extract. With water at 60°F. it would take 382,144 units. A ton plant is usually considered as one being able to convert one ton of water at 32°F. to ice at the same temperature or 318,080 B. T. U. One ton of refrigeration requires one B.H.P. for 24 hours for very large machines, but about two B.H.P. for small machines such as are needed in the average dairy. It is, however, necessary to consider the temperature of the condensing water—the cooler it is the greater the efficiency ; the humidity of the atmosphere is also a factor to be considered. In dairies it has been found that a Drum cooler by Heenan and Froude is a great help in keeping down the temperature of the condensing water; of course one may have a cooling tower instead, but it is not so efficient. Condensing water should be below 60°F. if possible; anything above that affects the output, especially with Co_2 machine.

If a machine is able to do one ton of work in 24 hours, it must be understood that only one-twenty-fourth will be done each hour, and in a dairy it is usual for all the milk to be cooled in two hours, *viz.*, one hour in morning and one in the evening. By storage of brine in an extra tank the work may be stored up ready for the cooling time, so that the machine may store up eight hours' work to be given up during the two hours when milk cooling is actually performed.

Generally speaking, a Hall's No. 4 machine is ample for a dairy dealing with 3,500 lbs. of milk a day and selling 400 lbs. of butter. For every additional 1,000 lbs. of milk and 100 lbs. of butter, the size of the machine should be increased by one, *i.e.*, for 5,500 lbs. of milk and 600 lbs. of butter a No. 6 machine is required. The above includes a cold store, brine cooling of milk, chilled water for butter-making, and storage of three days' supply of butter and one day's milk reserve.

The details of a cold store are dealt with elsewhere in the Journal.

It is usually most economical to use a steam engine in a dairy as it is necessary to have a boiler for pasteurization, steaming cans, making hot water for washing purposes, etc. Moreover, the steam engine is more reliable and elastic in its power ; of course there may be exceptions to this rule, for instance, in Mesopotamia, near the oil fields and far removed from the coal fields, it would be necessary to use an oil engine and as small a boiler as possible.

(*c*) It is imperative that the manager of a dairy should know all about his machinery, or he may suffer heavy loss when breakdowns occur, since milk cannot be neglected one day without very serious results. This is particularly so when one is using refrigerating machinery, since the routine has been changed in unison.

The manager must therefore set to work, and study some good text-book, and make himself practically cognisant of the particular machine he has decided to obtain ; there are many good books on the market, but perhaps the text-book for the N. D. D. examination is the most suitable for dairy manager. Some knowledge of various sciences is also necessary to enable the owner or manager to realise the uses of the various parts, materials, etc. The following are the most necessary :—

(*a*) *Bacteriology*, (*b*) *Chemistry and Physics*, (*c*) *Mechanics*.

(*a*) Because the whole installation is erected to check the growth of micro-organisms. It is owing to their activities that we need the refrigerator. It is our knowledge of their growth that has made refrigeration the active preserver of food products it now is. We must therefore learn something of these organisms to know just what temperatures are most suited to each product. It is of course known by investigation and on record, but it is always best to know the "why's and wherefore's" oneself.

Wallis Taylor says butter can be preserved by either keeping it in a chamber at the ordinary cold storage temperature (32° F.) or by freezing, the latter being said to give the best results as regards the retention of the flavour and other qualities of the butter. For lengthened storage it is recommended to

freeze the butter rapidly at a temperature of from 5° F to 10° F. and afterwards to keep it at about 20° F.

The thawing can be effected by simply removing it from the freezing chamber, and, at the time of selling, it is desirable to allow the butter to stand for a short time in order to develop the flavour.

Butter is an unstable product. It is at its best when freshly made. Strictly speaking, deterioration begins at once, and it will become noticeable sooner or later according to the condition under which the butter is kept. The most important condition in this respect is that of temperature, because no other condition has anything like the same influence in its preservation. The preservation of butter means the checking to a greater or less extent of the processes of fermentation that affect the flavour, and which are inevitable in all butter, but it has not been proved that even such extreme low temperatures will preserve the flavour indefinitely, although it has been found beyond doubt that the lower the temperature the longer it will be preserved. Fortunately there is a certain period in the life of all good butter, during which it may be considered to be at its best. Assuming that the butter has been well made, the duration of this period depends almost entirely on the temperature at which the butter is kept.

It was formerly held that the freezing of butter caused a rupture of the fat globules and produced a deterioration in the quality after thawing, but this idea has now been abandoned, and was not borne out by the experience of butter merchants. In fact for the storage of butter for any lengthened period of time in hot climates, or for transport by rail over long distances, freezing is usually advisable, as it has been found that butter so treated is far superior to that which has been chilled or kept in ordinary cold store. Frozen butter both retains its flavour and body better than the other, and, what is of considerable importance, is less easily affected by bad odours or other contamination. This result, however, depends to a great extent upon the care that has been bestowed upon making the butter, *viz.*, whether it has been washed quite clean, to what

extent it has been worked in the butter worker, and to the precautions that have been taken in packing whilst in a chilled condition.

Our experience in India is that chilled butter does not stand a long journey in the tropical heat. We have not, however, very much experimental data to work upon, but it is very much safer to cold store butter as near to the place of final consumption as possible. It is said that butter will not keep over 6 or 8 months even at zero. It should moreover be brought to zero gradually and also allowed to thaw gradually and not be given too sudden changes.

Milk should be kept as near as possible to 32°F. not frozen, but for ordinary station work 40°F. will suffice. For this purpose it is necessary to have a brine cooler with sufficient superficial area to deal with the amount in a reasonable time—say, 8 sq. ft. for every 1,000 lbs. per hour. It is also necessary to have a good reserve of brine. In dairies the brine reserve tanks are the most satisfactory and economical and not so heavy in initial cost. Allowing that the cooling water reduces the 2,000 lbs. of milk to 70°F., and it is needed to reduce it further to 40°F., *i.e.*, 54,000 B. T. U. is to be removed in 1 hour: say the brine is at 20°F. when commencing and at 35°F. when finishing: a reserve of 400 gallons of brine will be required. This is of course very liberal as heat is being extracted during the cooling hour, but it is seldom that a machine works in India to its full capacity. A centrifugal pump for circulating brine is usually much better than the plunger pump, ordinarily supplied with the refrigerating machine, and should be installed; this must be replaced periodically to clean and overhaul, therefore it is necessary to have a "Stand by."

A complete set of all wearing parts with ample new leathers for pistons, etc., should always be kept on hand.

The brine pipes and drums are naturally corroded in a short time by the action of brine, and it is as well to be prepared with duplicates.

The pipes should be cast in sections with flanges, it is then easier to replace a section, moreover it is usually the threaded ends of pipes which give way first; these should be avoided if possible.

(*b*) In *Chemistry* and *Physics* we are taught something of the various constituents of matter, and their relation to each other under various conditions.

Heat is perhaps the most complex physical subject under this head, and it has been defined by many great physicists, but they all equally agree that it is beyond their "ken" to define it satisfactorily. Lord Armstrong said : "According to the new theory heat is an internal motion of molecules, capable of being communicated from the molecules of one body to those of another ; the result of this imparted motion being either an increase of temperature or the performance of work."

Modern physicists assume heat to be not a material but a state. All bodies may be regarded as being made up of very small particles called "molecules" which, in the coldest bodies, are in a state of agitation. If by any means this agitation is increased, the body becomes warmer, and may eventually reach the condition termed heat.

Effects of heat can be summarised as follows :—(*a*) change of size, (*b*) change of state, (*c*) change of temperature.

All bodies expand when heated and contract when cooled. Heat will convert a solid into a liquid, *i.e.*, ice to water. Also liquid to gas, *i.e.*, water to steam. Heat is known as "specific" when it is registered on a thermometer and "latent" when not so registered but is used in changing a substance from one state to another, *i.e.*, the "latent heat of fusion" is 144 B. T. U. and the "latent heat of vaporization" is 966 B. T. U.

A *B. T. U.* is the amount of heat required to raise one pound of water to one degree Fahrenheit and is equal to 778 *ft. lbs.* by "Joules Law," and equals ·992 Calories or 1 *Calorie* equals 3·968 B. T. U. or the amount of heat required to raise one *Kilogram* of water 1°C. or 1 lb. of water 4°F. ; a *Therm* is 1,000 Calories.

1 *H. P.* = 33,000 ft lbs. per min.

1 *Kilowatt* = 1·34 H. P.

1 *Watt* = 1 *Ampere* and 1 *Volt.*

1 *H. P. hour* = 2,545 *B. T. U.*

1 *Gram* or 1 *C. C.* (Cubic Centimeter) = 1/453 of a pound.

1 *lb.* = 45·3 6 grams or c.c.

1 *Electrical Unit* = 1 Kilowatt hour or 1,000 Watt hours.

From these figures one can realise how heat and work intermingle, and become interchangeable. We are told that heat is not destroyed but only transferred from one body to another. We are also told that heat cannot be transferred from a colder to a warmer body except when its state is changed, but that the reverse occurs.

It is these facts which enables us to make artificial cold or ice.

Anderson says: "In refrigerating machines or heat pumps, certain fluids, *i.e.*, ammonia (NH_3), carbon dioxide (CO_2), sulphur dioxide (SO_2) are used for conveying the heat from the low to the high level. These are made to constantly change from a vapour into a liquid.

Air and water might be used, but do not act so efficiently as either of the first three mentioned.

Thermodynamically it does not matter what fluid is employed in a refrigerating cycle, yet certain characteristics, physical properties, and practical considerations limit the choice, which may be cited as follows :—

(1) It must be able to stand the temperatures and pressures employed.

(2) Its capacity for heat must be great in order to carry off the heat extracted from the body to be cooled.

If a liquid is employed then :—

(3) Its vaporizing point must be low, and the resulting volume not too great.

(4) Its pressures at the temperatures employed must be practicable.

(5) The relation of the latent heat to the specific heat should be high.

Air cannot be used as it is too bulky, and thus any cold air machine would be cumbersome and extravagant.

The first three fluids mentioned are therefore approximately nearest to the conditions required.

SO_2 is seldom used, as air is liable to leak into the machine owing to the pressure being 4·4 lbs. per

sq. inch below the atmospheric pressure—a condition which seriously interferes with the working.

The field is left practically to ammonia and carbonic anhydride. Of these the former has the advantage of comparatively low working pressures, whereas the latter has an advantage inasmuch as its increase in volume during vaporization is roughly only 1/33 that of the former.

For a given horse power expended the two would give as near as possible the same results, the difference, if any, being in favour of ammonia.

Cycle of Refrigerant.—The *refrigerant* is forced into the *evaporator side*, compressed and delivered to the *condensor side* by the *compressor*, where it is under considerable pressure and passes as a liquid to the *regulating valve* which allows a regulated quantity to pass from the pressure side to the evaporator where it evaporates, and the cycle is completed.

(1) *The evaporator side* is generally composed of coils of pipe through which the refrigerant passes as a gas, the outside of the coils being surrounded with "brine" where brine circulation is used, or by air where the direct expansion system is used. The brine or air gives up heat and is thereby cooled.

(2) *The compressor* requires to be driven by either steam, gas, or oil engine or electric motor.

(3) The *condensor* in general construction does not differ greatly from the evaporator. It consists of coils through which the refrigerant passes and is surrounded by the condensing media, usually water.

With regard to the thermal operations, and taking a diagram, it will be noticed that the heat is brought into the machine by the brine having been removed from the body to be cooled. The brine inlet is therefore the heat inlet. This heat is transferred to the refrigerant while in the evaporator, and is next compressed. At the end of this operation the refrigerant contains the heat removed from the body to be cooled, plus the heat equivalent of the work done during compression. This total heat is removed from the refrigerant by the circulating water, which is therefore the heat outlet.

There is less loss in the cycle with ammonia as a refrigerant by 5 per cent. than with CO_2. Ammonia

is, therefore, the more economical refrigerant, and this fact, in combination with the low working pressures, makes it the *favourite refrigerant.*

Taking all points into account, the claims of both ammonia and CO_2 would have to be considered with special reference to situation and purpose. We have already said that CO_2 is suitable for temperate climates, and that ammonia is more suitable for tropical climates, especially where much work is needed and the temperature cooling water is fairly high.

The Cycle of Brine in a dairy is usually from the evaporator to the (*a*) cold store, (*b*) the brine cooler for chilling milk, (*c*) chilled water tank and back to the evaporator. Where ice is made the evaporator is the ice tank. The circulation is carried out by a centrifugal pump through suitable pipes.

(*c*) *Mechanics* will be dealt with under Section III.

OIL ENGINES.

BY

MESSRS. RIDDICK AND WOODFORD, N.D.D.(I.)

THE use of oil engines has greatly increased in the industrial world during the past few years. They have attained such efficiency in power, economy, saving of fuel and labour that the needs of modern industry are in many cases best served by their utilisation. It is remarkable in India, considering the large number of oil engines imported, how very little is known of their method of working and the principles governing the efficient and economical running of these machines. They continue from year to year to give a certain amount of work, but it is maintained that at the very best they do not give anything like their maximum efficiency. This is principally due to the lack of trained native engineers in India who, with very few exceptions, have very little true knowledge of the working of oil engines. It is generally at the expense of the engine that these men pick up their knowledge, and consequently the loss, both as regards efficiency and repairs, falls upon the employer. It would seem necessary that, in order to combat this, better training schools should be instituted, so that employers could procure passed pupils from these colleges with the certainty that their training has been thorough and on the correct basis.

The object of this article is to give, in a concise form, many of the essential details needful in connection with the working of oil engines, in order that the employer or manager may be able to see that he is getting the very best result from his machinery. Not only are these engines used in the large commercial centres, where repairs and overhauling can easily be

carried out, but also in the far-away districts in connection with the baling and pressing of fodder and irrigation work. The need, therefore, of a working knowledge is most apparent when one takes into consideration the labour and other difficulties which one has to contend with in India. This article is not intended for the highly technical man, but for the beginner and student: the information being couched in simple language to be quite clear to those who have little previous knowledge of the subject.

Comparison of Oil Engines with Steam Engines.—Oil engines are said to possess the following advantages:—

1. Economy in establishment, since they require no stoker.
2. There is no risk of boiler explosions.
3. They require no coal, and hence no disposal of ashes.
4. There is no chimney, and consequent dirt from smoke troubles.
5. Little or no expenditure on water, as only sufficient water to cool the cylinder is required.
6. It has a better thermal efficiency, and consequently is more economical.
7. It requires less attention when once started, and therefore effects a saving in establishment.
8. Less care is needed, and it does not require a boiler.

In order to show the beginner how economy is effected by the use of oil engines in comparison with steam engines, a few simple figures and data which can be easily followed are here given:—

Coverton and Redwood state that one pound of oil yields from 18,000 to 20,000 heat units, whereas according to the R. A. S. E. tests one pound of coal yields about 14,000 heat units.

The thermal efficiency of the oil engine, according to the same Society's tests, is about 15 per cent. to 19 per cent., whereas that of the combined steam boiler and engine is from 3 to 10 per cent.

Then, again, one cwt. of oil will keep an oil engine at work for about 124 H.-P. hours, whereas one cwt. coal will only keep a small steam engine at work for 15 H.-P. hours.

12

In order to make a comparison between the cost of running an oil engine with that of steam, we are indebted to some of the figures given by W. A. Tookey in his excellent little book on Oil Engines published at one shilling.

If an oil engine is called upon to give, under a full load, 10 B. H. P. constantly throughout each hour, it would take a steam boiler $10' \times 4'$ size, fitted say with cross tubes, to give the same power. This boiler would evaporate from 3 to 5 pounds of water for every one pound of good coal used. The steam engine developing 10 B. H. P., which would probably be about 12 Ind. H. P. and, with a fairly simple engine, the consumption of steam would be for every I. H. P. from 40 to 50 pounds. Therefore 12 Ind. H. P. would require 540 pounds of steam per hour, equal to about 135 pounds of coal. Assuming that coal can be obtained in India at, say, Rs. 22 per ton or, say, Rs. 24 per ton stacked in a coal shed, the cost of the weekly consumption per week for 50 hours would be Rs. 66. Added to this mistri's wages, say, Rs. 10 per week *plus* a fireman's wages at Rs. 5 per week, and expense of removing ashes and waste, say, Rs. 3, the total cost, irrespective of repairs and other incidental charges, would be Rs. 81 for a week's running of 50 hours.

An oil engine doing similar work would need less than one pint of kerosine or petroleum oil in one hour for every B. H. P., *i.e.*, 10 pints for 10 B. H. P. per hour, or in one week of 50 hours 500 pints or 62½ gallons. Taking the cost of a really good oil at 11 annas per gallon, the cost would work out for 50 hours weekly at Rs. 50 nearly. The calculation made here, it must be remembered, is based on the use of a very good class oil, but cheaper brands can be obtained which will do the work satisfactorily. Then, again, the latest oil engines are fixed with appliances to enable crude oil to be used which is much cheaper than any of the refined or partially refined oils. Taking the same wages for the driver at Rs. 10 and eliminating repairs and renewals as in the steam engine figures, the saving would be Rs. 28 per week of 50 hours. In this comparison we have debited the maximun charges

against the oil engine and the minimum against the steam engine, as it will be readily understood that the firing of a boiler requires much more experience and careful training than one at the first glance would believe. It is more than difficult to get an Indian stoker to understand the value of banking the fire of a boiler, and a careful and regular feeding, and if one were to figure this out very carefully, the loss in this connection alone would be surprising.

In order that the reader may be conversant with the terms used in this article, as far as has been reached, it will be useful to explain them briefly.

Indicated horse power known by the letters I. H. P. refers to the power exerted by the steam in the cylinder as tested by an indicator.

Brake horse power (B. H. P.) is the nett useful power transmitted by the driving shaft as tested by a brake. It represents the ordinary working power of an engine, and is about three-quarters of an I. H. P.

Indicated horse power is equal to the work done in raising 33,000 lbs. weight through 1 foot in one minute which equals 33,000 foot pounds.

British thermal unit is the amount of heat required to raise one pound of water through 1° Fahrenheit.

The term thermal efficiency used in this article and the percentage of 15 to 19 per cent. in the efficiency of the oil engine is worked out as follows. It is stated that American oil has a heat unit value of about 20,190 B. T. U.'s per pound. Out of this only 15 to 19 per cent. of the heat can be used in driving forward the piston of an oil engine. The loss is explained by the cooling of the cylinder walls with water circulation, while a further percentage escapes with the exhaust. Therefore in 20,000 lbs. heat units of 1 lb. oil, 2,400 are ultimately available for transmitting power to the machinery.

How an Oil Engine works.—There are two types of oil engines in use, namely, the four-stroke and the two-stroke. The former is known as the "Otto or Beau de Rochas" Cycle, and as this is principally used in India, we will briefly explain the Four-cycle principle first.

The cycle has four distinct movements of the piston.

(*Suction.*)

The first or out-stroke.—A mixture of oil and air is admitted through the inlet valve which is held open by suitable means throughout the stroke as the piston is drawn forward by the rotation of the fly-wheel.

The second or in-stroke (compression).—The piston, moving backward, compresses the charge. The inlet valve closes mechanically, the temperature and pressure of the charge rising together until the stroke is completed. (This completes one revolution of the shaft.)

Third or out-stroke (combustion). The compressed and heated mixture with the rise in temperature and increase in pressure is fired, and causes an explosion which gives the piston a forward impetus. This gives additional momentum to the fly-wheel and constitutes the power stroke. As the piston moves forward the pressure and temperature decrease.

Fourth or in-stroke (exhaust).—Just before the completion of the third stroke, the exhaust valve opens and communicates with the atmosphere. As the piston returns in the cylinder, the combusted charge is expelled to the air through *the open valve, clearing the way for a fresh charge.* This completes the four-cycle operation, or second revolution.

Two-cycle engines.—In a two-stroke engine the explosion occurs once for every revolution of the crank shaft; consequently this type of engine has no suction and compression stroke as in the four-cycle type In the two-cycle type compression usually takes place in part in the crank chamber or by a separate compression pump. As the piston is forced down by the explosion, the exhaust port is uncovered and almost immediately after the inlet connecting the crank chamber with the cylinder above the piston is uncovered. A baffle plate, however, prevents the inflowing gases from reaching to the exhaust port at first, and before any serious loss could take place the exhaust port is covered up by the piston moving on its up-stroke. In order that the operations may be perfectly clear to the reader, we will briefly explain the cycle of operations in the Diesel engine, which is the best known of two-stroke engines. It must be primarily remembered that in this type of

engine the oil is not evaporated to form an explosive mixture. It is mechanically pulverised and burns, that is, does not explode in the engine chamber. The cycle of operations in the Diesel oil engine is as follows:—

First or down-stroke...	The air is drawn direct from the atmosphere into the cylinder.
First or up-stroke ...	This air is compressed. This compression causes the temperature of the air to rise sufficiently to ignite the fuel sprayed into it.

At the end of the compression stroke and during the first period of the succeeding down-stroke, oil is blown into the cylinder by compressed air in a finely divided state, not suddenly but over a measurable period of time, thus avoiding any rise of pressure after completion of the compression stroke. The amount of oil delivered is controlled by the governor so as to suit the load.

The next up-stroke is the exhaust stroke during which the products of combustion are expelled to the atmosphere.

There is no explosion or sudden rise of temperature in the working cylinder; as only air is compressed there can be no premature ignition; no sparking or ignition devices, nor carburettor or vaporiser required.

The difference between the Diesel and the so-called semi-Diesel engine is that in the former the air is compressed sufficiently to cause ignition and the oil is pulverised and introduced into the cylinder at the top of the stroke by means of air at a still higher pressure. In the semi-Diesel engine pure air is also compressed but not to such a high pressure, the ignition temperature being reached by means of a hot bulb into which the oil is injected by a pump at the top of the stroke.

The Diesel and semi-Diesel engines have been so improved upon of late years that it will in all probability supersede the four-cycle engine more especially where high horse-power is required and for marine work. Its fuel being a heavy type of oil (liquid fuel) the saving above all other engines is very considerable.

A new type of engine of the semi-Diesel kind has been constructed on the four-cycle principle.

Until we have a better knowledge in India of the mechanism and working of these engines, the four-cycle oil engine will remain the most popular.

(*To be continued.*)

CATTLE BREEDING IN INDIA.*

THE question of breeding cattle on a scientific basis must in the near future be seriously taken up in India, as the subject is of vital importance to the future of the dairying and agricultural industries.

On approaching this question it will be necessary to divide the problem into three parts :

1. What does India need ?
2. What basis have we in India upon which to work ?
3. How can we obtain from the basis available, what is needed in India ?

1. *What India needs.*—The community at large in India needs such a breed of cattle that a large milk yield may be obtained from the female, while the male remains a good draught bullock. The suitability of the male to draught conditions is imperative, since agriculture is the mainstay of India, and in India agriculture depends upon perfect cultivation more than it does in any other country in the world. Other countries have stock grazing lands, but in this country the grazing areas are comparatively small, invariably neglected, and of poor soil. Gujerat contains the largest milch cattle population per acre in India, and in that district there is no grazing; all fodder is produced by cultivation.

The fact of the necessity of a milking female and a working male from the same breed is obvious, and we are at once confronted by the problem : "Can we produce a breed of cattle which will fulfil these two vital conditions ?" Many recognised authorities denied that this was possible, but of those many are coming round to believe that such a combination is possible and that there are

*Notes taken by Mr. Woodford at a lecture to military farm students delivered by Mr. W. Smith at Ahmedabad on 6th November, 1916.

no valid reasons against the supposition. In an advanced milking breed, all the maternal instincts and the feeding of young have been developed to the highest pitch, which is an enormous help in breeding a draught bullock, since a first-class milk-giving animal is necessary to rear first-class progeny.

Commercial economy must necessarily be the foundation of the work of breeding. Having attained the type of cattle detailed above there will be two ways of making money open to the farmer and breeder.

(*a*) By sale of the males or utilising them on his own lands.

(*b*) By disposing of the milk from the female.

Hence if a type of animal is produced of which the male realises in the market a remunerative price, and the female produces a large quantity of milk, the commercial needs of this country will be satisfied.

A dam that is not a good milker cannot produce the above requirements in her sons and daughters In India, speaking generally, neither the bull nor the cow is looked after. In some districts, the bull is neglected and becomes an incubus on the community, while the cow is cherished for her milk ; in other districts the cow runs unwanted and neglected, and the bullock is taken for cultivation. All breeding is just accident and haphazard, and this is the reason that there are 170 million cattle in India, where 100 million could do the work, and be sufficient to the needs of the population.

The dual purpose breed for India must mean milk and draught; beef is not wanted as there is no large market for it. The male and female would be each equally useful in their respective lines.

It has been sometimes thought that the most satisfactory way out of the difficulty is to keep the buffalo for milk and the male cow for draught. This means a waste of one sex of each, which is neither businesslike nor economical.

2. *The basis upon which to work.*—It may be safely assumed that there is a fairly good plough bull already, but the female is no milker. The Indian can get almost as good a working bullock as is obtainable in Europe, but cannot get a milker like those of Switzerland and Italy. The Swiss Jura Mountains yellow

breed supplies bullocks for the working of tbe Rhone vineyards at £200 a pair, and show cows of the same breed have given 16,000 lbs. of milk per average lactation for three years running. The absence of such conditions as this in India and the want of a good cow accounts for the presence of the buffalo, but, as before mentioned, the method of keeping buffaloes for milk and bullocks for draught necessitates double the expense and is therefore economically unsound. No country can afford to have its breeding problems based on wrong commercial principles.

The average Indian cow scarcely pays for her feed by her production of milk, so with an animal of this description there is nothing to work upon.

3. *How to obtain what is needed.*—There are only two practicable ways, *viz.* :—

(*a*) To import animals of a good milking strain and introduce that strain into the indigenous cattle.

(*b*) By the slow process of selection within the country breeds. This will need six generations to obtain appreciable results.

(*a*) The importation of bulls of milking strain.—This method is quicker and it would seem that the question is solved by a cursory thought. Great care is, however, needed that the draught powers and other characteristics wanted in the half bred, resulting from the cross between the imported and country strains, may not be destroyed. Certain characteristics, too, which may or may not be known are added from the imported strain, and may not be exactly what is wanted. On the side of the imported strain, which would be bulls of fixed heredity, there is a long line of selection and fixing. On the side of the Indian cow there is no breed and no fixed characteristics. Hence the sire's qualities predominate and may predominate to an extent almost disastrous, as many of these qualities, such as susceptibility to epidemic diseases, are bad from an Indian point of view.

Take for example, the high degree of hereditary immunity from the attack of disease of the Indian cow; they have met and struggled with disease so often that resistance has become natural. This immunity is only inherited in two cases out of ten in the half bred,

through the predomination of the fixed line, which carries little or no immunity.

(*b*) Selection from Indian cattle.—This method would be safe, but it would take 50 years to fix the type, and time cannot be neglected in this case. It has taken the people of Holland 170 years to breed up what is now known as the Holstein Fresian breed of cows. We must be more rapid than this in India. The question is therefore thrown back on imported cattle for the dual purpose. All other countries which have done anything in the line of breeding up cattle have taken breeds from all over the world to get what they wanted; India cannot afford to refuse to do what Japan, Brazil, and Africa have done.

Lines on which to work: Mendelian Theory.—Breeding in India, with the object of fixing a type of dual purpose cattle for milk and draught, can only be done on the lines of Mendelism, which is, in short, that characteristics are handed on from parents to progeny on an arithmetical basis. Complications arise in this Mendelian ratio, but there is always a rule to cover them.

By working in accordance with the law, it may be possible with scope and care to breed an animal with just those characteristics wanted, and to get rid of those not wanted. To go into particulars, we want the imported line's milking characteristics and the dam's immunity to be dominant.

We also want the spirit of the imported animal and the stamina of the dam's type dominant in the same cross bred.

The imported fixed line.—A criticism of the breeds obtainable for import into India, quickly decides the question of where the breed that is to bring milk to India may be found. The Jerseys and Guernseys are not suitable, since we already have a good fat percentage in the milk of the indigenous cows. Shorthorn bulls are very costly and the Holstein, with delicate constitution and huge barrel, has no capacity for muscle forming. Good Ayrshire bulls can be obtained for £40 a head. The breed is the hardiest of all British breeds, their home being in a tough climate. They have the frame from the draught point of view, and the bull is high spirited. This last quality is of great importance since,

when broken to the plough, spirit is needed so that the bullock will pull anything he can move. The Ayrshire seems to fill the place more completely, especially from the military farms' point of view.

To sum up, we must do away with everything but a type possessing a milking female and a working male, and carrying hereditary immunity and breeding, in accordance with Mendel's theory.

MATURE AND IMMATURE CORN FOR SILAGE.

There is considerable difference of opinion among farmers as to whether it is advisable to sacrifice something in quantity in order to secure maturity in corn grown for silage purposes.

During the summer of 1915 preparation was made to conduct a test with early maturing and late maturing corn. Longfellow was selected for the early maturing variety, and Mammoth Southern Sweet for the late maturing. We also planted two intermediate varieties, namely, White Cap Yellow Dent and Wisconsin No. 7. The four varieties were planted on May 31st in the same field, and all had the same cultivation The season was somewhat backward until August, so that none of the varieties reached as full a stage of maturity as would probably have been reached in a normal season. The corn was all in the silos by September 26th.

At the cutting the grain of the Longfellow was glazed and in the firm dough stage. That of the two medium varieties was in the milk stage, and in the case of the Mammoth Southern Sweet, the ears were just forming. The Mammoth Southern Sweet was put in a separate silo, so that comparisons could be made of this variety with the others. Up to the present, only one comparison has been practicable, namely, that of the Mammoth Southern Sweet silage with the silage from the Longfellow variety. A little later we will be able to secure comparisons of Mammoth Southern Sweet with the two medium varieties.

Whether it was owing to the season or to some other cause germination was only fairly satisfactory, but there did not seem to be much difference among the

varieties in this respect. The yields per acre of green material were as follows :—

Mammoth Southern Sweet	...	11 tons— 414 lbs.
Wisconsin No. 7	...	10 tons—1,840 lbs.
White Cap Yellow Dent	...	10 tons—1,685 lbs.
Longfellow ...	...	9 tons— 470 lbs.

The corn lay in the sheaf for two days before it was put into the silos, and no doubt lost considerably in weight during this period.

It will be seen, therefore, that the Mammoth Southern Sweet yielded nearly two tons per acre more than the Longfellow. This of course was the weight of the green corn, and we cannot tell how much silage was produced per acre by the different varieties until all the silage has been fed. The silage from the Southern Sweet has a decidedly more acid smell and taste than that from the Longfellow.

Feeding Tests.

As stated before, we have as yet been able to conduct tests with only two varieties, namely, Longfellow and Mammoth Southern Sweet. With these varieties two tests have been made with dairy cows.

In test number one, three cows were fed for two weeks on Mammoth Southern Sweet silage, followed by two weeks on Longfellow silage. Three other cows were fed two weeks on Longfellow silage followed by two weeks on Southern Sweet. All other kinds of feed were kept as nearly the same throughout the four weeks as it was possible. In making the comparison, we are using only the second week of each period, the first week being omitted to allow the cows time to become accustomed to the change in feed.

The results in milk production are as follows :—

6 cows on Longfellow silage produced 1,585·2 lbs. milk in 1 week.

6 cows on Southern Sweet silage produced 1,510·3 lbs. milk in one week.

This gives a difference of 74·9 lbs. milk in favour of the Longfellow silage. During each week the six cows consumed 1,512 lbs. of silage, and, since the other feed was the same throughout the test, the only conclusion open to us is that the difference in milk production was

due to the difference in quality of the silage, which may or may not be correct, because in any feeding test the individuality of the animals always enters into the problem.

If we assume that 1,512 lbs. of Longfellow silage produced 74·9 lbs. of milk more than the same quantity of Southern Sweet silage, and if we value milk at $1·60 per hundred (which is the price we are receiving for it) then a little mathematical operation shows that one ton of Longfellow silage, in this test, was worth to us $1·58 more than one ton of Southern Sweet. This looks extremely high, and in the light of the following test it is probably a good deal higher than we are warranted in expecting in all cases.

Test number two was conducted in a different manner. Eight cows were fed on Southern Sweet silage for two weeks, then they were fed Longfellow silage for two weeks, followed by another two weeks period of Southern Sweet.

In reckoning results, the average milk production during the two periods on Southern Sweet was compared with the middle period on Longfellow silage. As in the previous test, only the second week of each period was considered for reasons previously given, and throughout the six weeks all other feeds consumed by the cows were exactly the same from day to day.

In test number two 8 cows produced 1,931·3 lbs. milk in one week on Longfellow silage; also, 8 cows produced an average of 1,887·9 lbs. milk in one week on Southern Sweet silage.

In this test, therefore, we have a difference of 43·4 lbs. milk in favour of the Longfellow silage. The 8 cows consumed 1,778 lbs. of silage during each week, and, therefore, on the assumption used in the previous test, 1,778 lbs. of Longfellow silage was worth 43·4 lbs. milk more than the same quantity of Southern Sweet silage. Valuing milk as in the previous test, we find that Longfellow silage, in test No. 2, would be worth 78 c. per ton more than Southern Sweet silage. This difference, in favour of Longfellow, is barely half the difference shown in the previous test, and there is no way of explaining the variation in results, except that the individuality of the cows has had an influence in bringing about this discrepancy.

It is interesting to note, however, that in each test there was a pronounced difference in favour of the silage from the more matured corn, although it would be unsafe to make any positive statement as to just how great this difference was, with the meagre evidence before us. It will be necessary to do considerably more work along this line before we feel safe in drawing anything but the most general conclusions.

Difference in Value Per Acre.

A rather interesting comparison can be made on the basis of the yield per acre.

The Longfellow yielded nine tons four hundred and seventy pounds per acre of green material.

According to test No. 2, and assuming that the weight of silage is the same as the weight of green material, the 9 tons 470 lbs. of Longfellow silage grown upon one acre would be worth $7·20 more than the same weight of Southern Sweet silage. Thus, the $7·20 additional value of the Longfellow silage on the one acre must be set off against the extra two tons of Southern Sweet silage produced per acre, so that in test No. 2 no particular advantage is shown in favour of either variety, when it comes to value of product per acre

Using the same process in test No 1, we would have $14·59 to set against the extra two tons of Southern Sweet silage, so that we may safely say that test No. 1 shows a marked advantage in favour of the early maturing but lighter yielding variety.

The figures just given are not entirely satisfactory, because they should be based upon the yield of silage per acre and not upon the green material, but, as previously stated, we cannot ascertain the actual yield of silage until all the silage has been fed.

Though incomplete, the figures given are interesting and suggestive, and indicate the necessity for further work along this line.

DIFFERENT KINDS OR TYPES OF SOIL IN RELATION TO CROPS.

BY

J. F DUGGAR.

On the basis of their mechanical conditions soils may be divided into three principal classes (1) Those consisting chiefly of clay and silt; (2) those made up chiefly of sand; and (3) those consisting of a mixture of sand and clay in the proportions to form loamy soils

. Let us note first the main characteristics of clay soils as they determine the choice of crops best adapted to such soils. Clay soils as a rule are wet, usually requiring especially good artificial drainage. This large content of moisture causes the crops grown on them to start slowly. The excess of moisture, or rather its continuous presence in abundance, tends to make crops produced on clay soils develop a large amount of stem and foliage in proportion to fruit. Such soils are worked with greater difficulty than others, and they bake or become cloddy unless ploughed or cultivated at exactly the proper time.

Each of the considerations mentioned is an argument for devoting such land, so far as practicable, to the broadcast, uncultivated crops, especially the grasses for hay or even the pasture grasses. Such soils if well drained are apt to be relatively fertile and hence may be especially suited to corn.

Sandy soils are exactly opposite in agricultural qualities to clay soils. The former are usually well drained, if the subsoil also be sandy, and quickly dry out to a point at which crops may make a rapid growth. Sandy soils also absorb heat quickly, and on such soils the action of fertilisers is usually quicker than on stiffer

soils. Therefore the trucker who wishes to grow vegetables for the early market chooses very sandy, well drained soils especially for his truck crops that make their principal growth in the late winter and early spring

Notable examples of such early crops are snap beans, English peas, Irish potatoes, and tomatoes.

Among farm crops better adapted than others to make successful growth on light sandy soils are sweet potatoes and peanuts. To both of these crops there is an advantage in mellowness of such soils, permitting the easy penetration of the peanut "needles" or pistils—destined to develop into nuts—and also making easier the development of the tubers of the sweet potato plant.

Since deep sandy soils are usually poor in plant food, the legumes are often selected because of their ability to grow without much nitrogen in the soil and because of their effect in transferring nitrogen from the air to the soil for the benefit of succeeding crops of non-leguminous plants. Hence peanuts, velvet beans, cow peas, soy beans, and even beggar weed are often grown on these light soils. They are somewhat better adapted as a rule to cotton than to corn, for reasons connected with the moisture requirements of these two plants at critical stages of their development.

Loamy soils are adapted to a wide range of crops. In fact it is scarcely too much to say that they are suitable for all the commonly grown crops of the farm and garden.

Each of the three classes of soils previously mentioned may be again divided into bottoms and uplands.

Bottoms, unless extremely sandy, are usually better supplied than uplands with a sufficient amount of moisture for the continuous growth of all ordinary farm crops. Hence in their moisture relations bottom lands are generally adapted to about the same crops as are the moisture-holding clay lands. Because of the abundant and even supply of moisture, bottom lands are especially suited to crops making a large leafy growth, such as sugarcane, silage corn, grasses for hay, especially Johnson, Sudan, and orchard grass. If the soil of bottom land is acid it is usually well adapted to red top grass and to carpet grass. Lespedeza also seems

to tolerate considerable acidity, although it thrives even better if some lime be present. Some lime is essential to the best growth of white and alsike clovers, which are better adapted to bottom than to upland. On bottoms may also be produced a large yield of sorghum forage, whether the soil be slightly acid or rich in lime.

Among the crops to which bottom land is usually less suitable than upland are truck crops for the early market—watermelons, cowpeas grown for seed, sweet potatoes, and peaches. This is partly because these plants tend on land continuously moist to make too much growth of wood or leaves.

Wheat is often at a disadvantage on bottom land, because of the greater liability there to rust and to lodging.

In the boll weevil region one should generally avoid planting the bottom lands in cotton, since the luxuriant growth gives the boll weevil opportunity for doing its maximum damage.

Soils may be divided, from the standpoint of crop adaptation, into acid, limy or calcareous, and neutral soils. As a rule most crops grow fairly well on neutral soils, but the plants most generally cultivated are at a disadvantage on soils that are distinctly acid. Among the crop plants for which it is desirable to select a soil rich in lime are alfalfa, red clover, and sweet clover or white melilotus.

Soils may also be classified according to topography, that is, according to how they lie. The surface may be nearly level, gently rolling, or steep. It is, as a rule, a mistake to cultivate land on extremely steep slopes, which find their best use in growing timber or perennial pasture plants.

QUESTIONS SET AT THE LAST N. D. D. EXAMINATIONS.

SECTION 8 —REFRIGERATION.

Question 1.—Explain what you know of sensible heat and latent heat?

Answer.

Sensible heat is heat that may be felt and registered by means of a thermometer.

Latent heat is the heat required to change a solid body at a certain temperature to a liquid at the same temperature, or a liquid to a gas, similarly without changing its temperature. In the former case it is termed the latent heat of fusion, and in the second case the latent heat of vaporisation.

Familiar examples on a dairy are the melting of ice, when it will be found that a given quantity of ice at 32° F. has a far greater cooling effect than a similar quantity of water owing to the latent heat taken up in the process of melting, and again in a steam boiler when immense quantities of heat are taken up from the fire to convert boiling water at 212° F. to steam at the same temperature.

Question 2.—What is the cycle of operations in a refrigerating plant on the compression system?

Answer.

The cycle of operations in a refrigerating plant is :—

1. Compression. 2. Condensation.
3. Evaporation.

Compression is carried on in the compressor and the refrigerant remains under compression until it reaches and passes the regulator.

Great heat is generated by the compression of the refrigerant from a gaseous state, and this is removed by

the cooling action of the cold water passing over the coils.

Condensation takes place in the condensor and is effected by cooling the coils through which the refrigerant is passing.

Evaporation occurs immediately the refrigerant passes through the regulator valve and the latent heat of vaporisation is taken from the air or liquid surrounding the evaporator coils. In a direct expansion system it is the air of the store which is thus cooled, but in an indirect expansion system the coils are immersed in brine which is circulated by means of a pump to wherever the cooling effect is desired.

Question 3.—What do you understand by a double acting compressor; and how many suction and delivery valves are necessary for such?

Answer.

A double acting compressor is one in which compression is carried out in the cylinder on both sides of the piston, that is, the upward stroke compresses the gas in the upper end of the cylinder and the down stroke similarly compresses it in the bottom of the cylinder. Two suction and two delivery valves are necessary for such a compressor. The advantage of a double acting compressor is increased efficiency, but it has a slight drawback that there is very heavy pressure on the gland, which may occasionally leak.

Question 4.—Explain the meaning of the following:—Refrigerant; B. T. U.; Direct Expansion; Regulator; Chilled Water; Thawing Tank.

Answer.

A refrigerant is the medium used to produce the cooling effect in a refrigerati g machine. It must be capable of evaporation at a comparatively low temperature, and recondensation at about the normal temperature of water, to have the greatest effect. Carbon dioxide and anhydrous ammonia are familiar examples of refrigerants.

British The mal Unit, or B. T. U., is the unit used in Great Britain for measuring heat. To be exact, it is the amount of heat required to increase the temperature of one pound of water one degree fahrenheit.

It is fixed by taking water at its greatest density, *i.e.*, 39°F.

Direct Expansion is the term applied to a refrigerating plant in which the evaporator coils are situated so that they absorb heat directly from the room or substance it is desired to cool. It is eminently applicable to the cooling of large stores, but not so suitable for general dairy purposes where cooling effect is desired in various places and at different times.

Regulator is the name applied to the valve which separates the condensed refrigerant from the evaporator coils

Its function is to maintain the compression in the system and regulate the passage of the refrigerant into the evaporator. It requires to be closed slightly when compression is deficient and opened when the pressure is excessive.

Chilled Water is useful in butter making to avoid possible contamination by impure ice. It is prepared by immersing brine coils in a water tank and circulating brine until temperature of water is brought down to desired point.

Water would be considered "chilled" at about 40°F.

Thawing Tank.—A thawing tank is a tank in which hot water may be placed in which to immerse ice moulds before emptying. The immersion causes the ice immediately next the mould to melt and the block of ice slides out whole.

Question 5.—What is the benefit of keeping brine at a certain density; and at what density is it most suitable?

Answer.

Brine must be kept at a certain density to prevent freezing. The density must always be regulated by the temperature it is desired to work at. A brine which is too weak will freeze, while a brine too dense has less efficiency owing to the reduction in the specific heat.

A suitable density for dairy purposes is 1·040.

Question 6.—Give a rough sectional sketch of a cold store showing insulation and arrangement for drainage.

Answer.

Below will be found a circular and sketch of the recognised cold storage room as published by W. Smith:—

INSULATION OF COLD STORES.

BY W. SMITH.

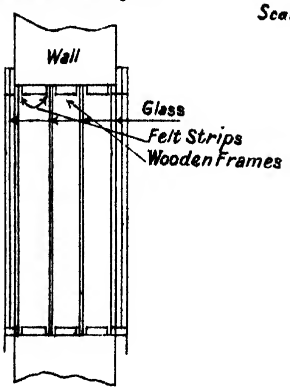
Past experience in Military Dairy Farms has shown that the use of timber of any class for the construction of the insulated walls of cold stores is not satisfactory, and it has been found that asbestos cement slabs take the place of timber as the most suitable material for walls and roof and cement concrete for floors. Walls and ceilings of cold rooms should be insulated with 8 inches of silicate cotton (slag wool) packed to a density of 15 to 18 lbs. per cubic foot between double slabs of $\frac{3}{16}$ inch "eternit" or similar asbestos cement sheeting having "Willesden" or P. and B. insulating paper between the slabs, care being taken that the joint of the outside slab is opposite the centre of the inside slab in each case. The joints on the outside and inside are covered with a teak lath (as shown in cross section attached). The double asbestos slabs should be carried on a light lattice girder framework of teak wood as per cross section and should be fastened by means of brass wood screws passed through countersunk holes drilled through the eternit sheets. Where it is necessary to support brine drums from the roof of the store these should be hung from iron girder framework supported by upright or adjacent walls, the whole being erected entirely outside the insulation of the store and the iron bolts or hangers only passing through the insulated roof as shown on sectional drawing.

The floors of cold storage rooms are best constructed of cement concrete with silicate cotton insulation as above. When preparing the floor of an insulated room on an existing concrete floor, cement concrete pillars, 2 inches square by 8 inches high, should be erected all over the space to be covered by the floor of the cold store one foot apart. The floor space between these should be covered with P. and B., or "Willesden" insulated

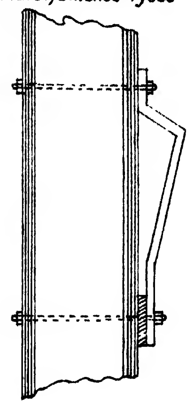
DETAILS
of
COLD STORE CONSTRUCTION

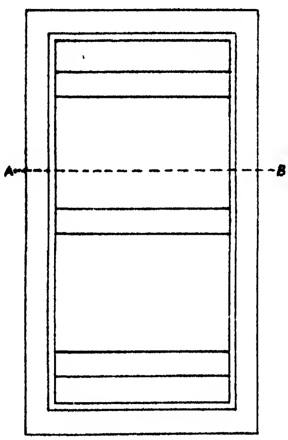
Scale 5/8 inch = 1 Foot

Vertical Section of Window
Scale 1½ inches = 1 foot

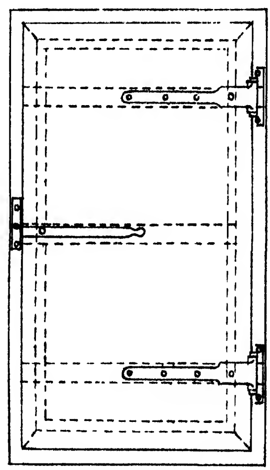


Door Fastening
Scale 1½ inches = 1 foot





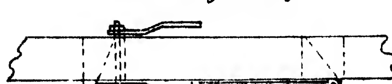
Back View of Door
Shewing Bevel



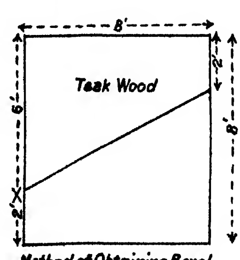
Front View Door
Shewing Fastenings

Sectional Plan Through A.B.

Silicate of Cotton

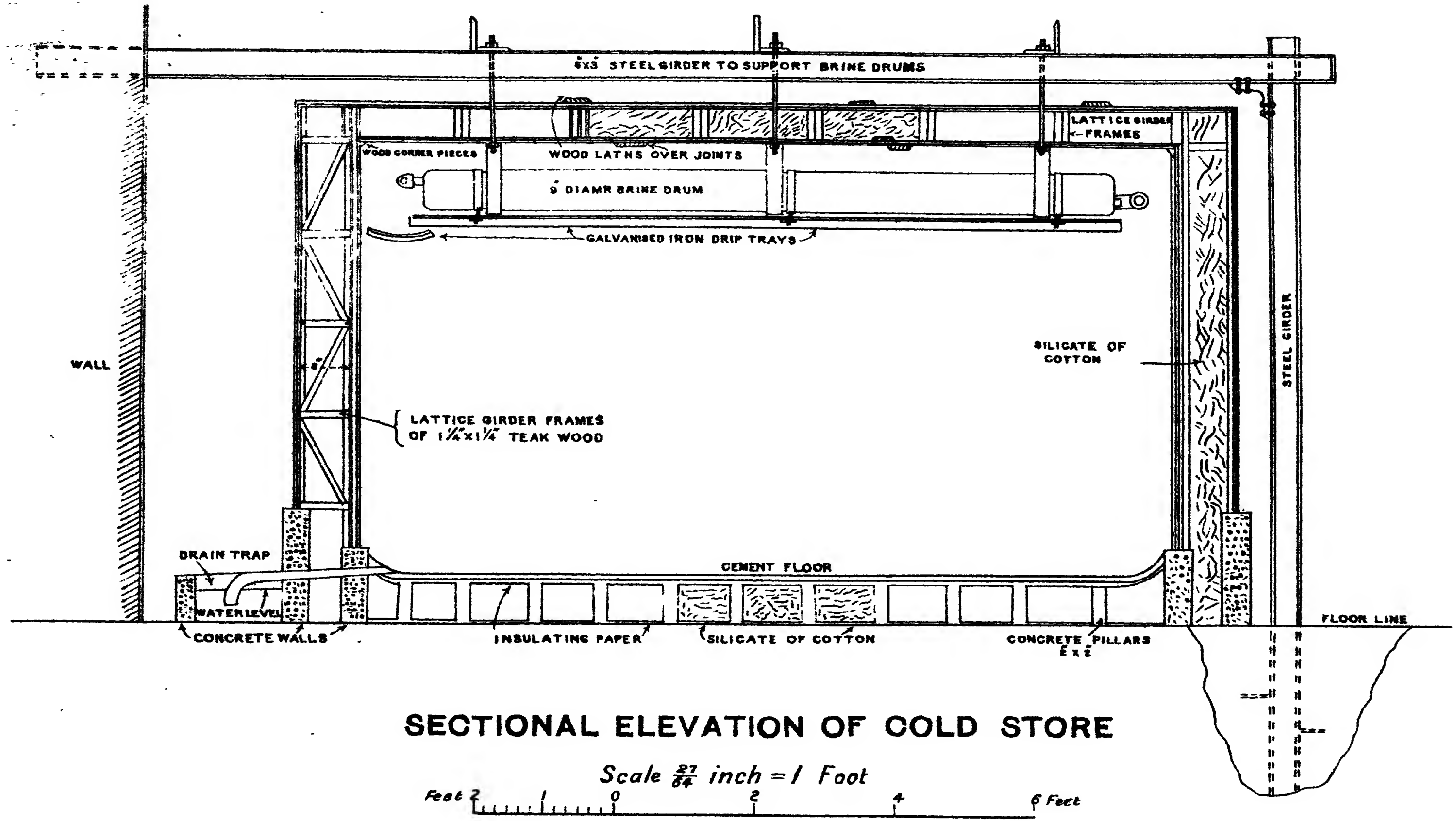


Door Handles Outside & In



Method of Obtaining Bevel
For Doors & Frame

S.D.O. No. 1130 January 1915



SECTIONAL ELEVATION OF COLD STORE

Scale $\frac{27}{64}$ inch = 1 Foot

paper, and a layer of pure bitumen $\frac{1}{4}$ inch thick applied hot over the top of the insulating paper. This prevents damp arising into the silicate. The silicate cotton is then filled in until perfectly level with the top of the small cement pillars and more insulating paper laid over the whole and 2 inches of the very best cement concrete laid on. Floor should be sloped 1 in 48 towards an opening at one corner with pipe passing through the insulation and a trap immediately outside to prevent air inlet (*see* sectional drawing).

Concrete floors should be carried up 6 inches all round the walls of the store and the inside eternit sheeting fitted into it. It is advisable, in order to prevent moisture getting into the insulation, that the outside wall should also be of concrete 4 feet above outside floor level as shown in drawing.

The accompanying sketches illustrate fully the manner of laying this class of floor and of connecting it with the cold storage walls.

In all cases it is desirable to have a protective room or air lock leading to the cold store proper, and the walls, floor, and ceiling of this should be insulated in exactly the same manner as above described.

The doors of cold stores and air locks should have bevelled frames and be insulated exactly similarly to the walls. These should be jointed, both on a bevel framework and in bevelled edges of the door, with heavy baize cloth or felt and fitted with heavy lever fastenings opening from inside and outside. If the latter only are used and anyone happens to be shut in the store, it is difficult for such a one to make himself heard through perfect insulation.

See sketches of door framework, hinges, and fastenings. In the case of cold rooms for storing ice, or for keeping produce which will be stored for some time and only put in and taken out once, it is advisable to have the door in the roof of the store, but this plan, although most efficient, is not practicable for ordinary practice.

It is advisable, where possible, that both cold store and air lock should be provided with windows. In a store of, say, 800 cubic feet capacity the windows should not exceed 1 foot 6 inches square, and in any dairy cold store they should not exceed 2 feet square for every

2,000 cubic feet of capacity. It is best to have windows fitted into the centre of the roof, but this is often not practicable where brine drums or grids are used, and where this is not suitable they may be placed in the centre of a wall where they are not exposed to direct sunlight. It is advisable to fit four panes of common glass to cold store windows with an air space between each. The outer panes should be flush with the insulated wall or roof and the whole airtight. *See* sketch.

Cold stores constructed on this plan are lasting, impervious to moisture or variations in temperature, and have given most excellent results on Military Dairy Farms.

The outside wall may be painted as desired, but on no account should the inner wall be treated with oil paint, as it is most difficult to eradicate the smell. The asbestos cement sheeting may be had in two colours, either grey or red, and as it is not affected by water the walls may be washed down inside and out. These stores present a neat appearance without paint of any kind.

Section 9.—Chemistry and Bacteriology.

Question 1.—Give the two chief thermometric scales and the formula for their conversion?

Answer.

The two chief thermometric scales are :

1. Fahrenheit. 2. Centigrade or celsis.

The former is graduated from 0 to 212 : 32 degrees mark the freezing point of water, and 212 degrees mark the boiling point.

The second is the scale now generally used on the Continent and is certainly an improvement on the fahrenheit.

It is graduated from 0 to 100 : 0 degrees marking the freezing point of water and 100 degrees marking the boiling point of water.

The formula for conversion from fahrenheit to centigrade is—

Number of degrees fahrenheit *minus* 32 multiplied by $\frac{5}{9}$.

Let F = Fahrenheit : Number of degrees.

Let C = Centigrade : Number of degrees.

Then $(F - 32) \times \frac{5}{9} = C$.

And to convert centigrade to fahrenheit the formula is—

Number of degrees centigrade multiplied by $\frac{9}{5}$ *plus* 32 or $(C \times \frac{9}{5}) + 32 = F$.

Question 2.—State what you know of the following terms :—(*a*) Elements ; (*b*) Carbo-hydrates ; (*c*) Albuminoids ; (*d*) Specific Gravity ?

Answer.

(*a*) *Elements.*—An element is a substance which cannot be broken up into two or more different substances. The atoms which constitute it are (it may be) joined among themselves to form molecules, but *there is only one kind of atom present in a substance if it is an element.*

Example.—The gas oxygen : A jar full of oxygen, having nothing else mixed in it, contains only oxygen atoms.

A jar full of water contains oxygen atoms, but each oxygen atom is joined to two hydrogen atoms, the three making a molecule of water. Thus, water is not an element. Every compound must be made up of two or more elements.

The word 'elements' is loosely used to mean air, wind, rain, etc., but always so in the plural.

(*b*) *Carbo-hydrates.*—This is a name given to a chemical group of substances which have carbon, hydrogen, and oxygen in their composition. The word 'Hydrate' refers to water. All carbo-hydrates are a combination of carbon and water. The chemical formulæ of carbo-hydrates almost always shows hydrogen and oxygen (H and O) in the proportion of two of hydrogen to one of oxygen.

Example :

Lactose $C_{12}\,H_{22}\,O_{11}$
or $C_{12}\,(11\,H_2\,O)$

Carbo-hydrates form a very important part of animal food. They go to form heat and energy, and if in excess of requirements for that, they aid the albuminoids in building up the body.

(*c*) *Albuminoids.*—This is a very loose term used to denote nitrogenous chemical compounds found in animal food.

An example may be seen in milk where casein and albumin form the 'albuminoids.' From the word itself one would judge that it means those chemical substances similar to albumin, and this is a very fair way of taking the word. Albumin contains nitrogen, hydrogen, oxygen, carbon, sulphur, and phosphorus, and chemical substances of a similar composition to this are known as albuminoids. They form in the animal body, tissue, nerve, and muscle, and are known as the 'body-builders.'

(*d*) *Specific Gravity.*—This is the weight of a unit volume of any solid or liquid substance as compared to the weight of a unit volume of water. Water is always taken as 1 Specific gravity is sometimes known as 'relative density.' In the case of gases, the comparison is made with the weight of a unit volume of hydrogen which is taken as 1. If salt is dissolved in water the specific gravity of the liquid with salt in solution becomes greater and increases proportionately with the amount of salt taken into solution. This fact is used in determining the amount of solids in milk and is worked out on a formula once the specific gravity is known. The 'specific gravity' is found by means of an instrument loaded at the bottom which floats to a certain mark in distilled water at 4°C., or at 39° to 40° F. By graduations, all liquids are compared to this mark. The 'lactometer' is an instrument of this kind especially made to accurately read under the conditions of milk. This instrument enables us to find the proportion of total solids in milk as compared with the amount of water: thus adulteration can be detected. Pure milk should vary between 1·028 and 1·032. The fat test in conjunction with the lactometer is an almost infallible detector of adulteration with water.

The figures given above for milk mean that a quantity of milk occupying the same space as 1,000 ounces of water would weigh 1,028 to 1,030 ounces.

Question 3.—To what useful purposes can the following be put on a dairy farm :—

(*a*) Soda ; (*b*) Ammonia ; (*c*) Lime ; (*d*) Nitrogen ; (*e*) Carbonic Acid Gas.

Answer.

(*a*) *Soda* as a general term includes all the compounds of sodium. In the home it means sodium carbonate, and this 'soda' is used in the dairy for general cleaning. It has the power of saponifying fat, and hence effectively removes grease from cans and bottles and floors, etc.

'Caustic soda' is used in the laboratory in testing milk or cream for acidity.

Phosphate of soda is used as an artificial manure.

'Glauber' salts is a soda used medicinally in the cattle yard. Other sodas are found in the pharmacy being contained in many prescriptions for various maladies of cattle.

(*b*) *Ammonia* is used—

1. As a medicine being a tonic.

2. In the soil as the source from which the soluble nitrates are made, coming itself from protein. Hence ammonia is valuable for plant food.

3. As a refrigerating medium NH_3 machines are said to be very suitable to hot countries.

4. As a disinfectant when in solution

(*c*) *Lime*. Any compound of calcium is a lime. Hence the uses are—

1. As a disinfectant, calcium oxide.

2. As an aid to refrigeration 'brine,' calcium chloride

3. Keeping a good appearance on the farm as well as its disinfecting properties. Mixed with separated milk it makes a lasting wall wash.

4. As a plant food; necessary in all good soil.

5. Lime in the soil fixes the phosphates; a valuable plant food and prevents their loss.

(*d*) *Nitrogen* is found of value in—

1. Animal food albuminoids. 'body builders.'

2. As a constituent of ammonia.

3. In the nitrates which are so valuable part of plant food in the soil.

4. It gives animal manure the value it has because of its presence, and in urine even more so.

(*e*) *Carbonic Acid Gas* (CO_2) is useful—

1. As a refrigerating medium.

2. As a plant food.

Question 4.—Give four forms of bacteria and one serious disease under each form?

Answer.

4.

	Forms of Bacteria.	*Shape.*	*Disease.*
1.	Cocci	Spherical	Gonorrhœa.
2.	Bacillus or Bacteria	Rod-shaped	Hæmorrhægic Septicæmia.
3.	Vibrio	Half spiral	Cholera.
4.	Spirilla	Spiral	Relapsing fever.

Question 5.—State what you know of sporulation and how spores affect disinfection?

Answer.

5. Sporulating bacteria have a power of changing into what is known as a 'spore' under adverse conditions to their life and remaining in that condition until better conditions re-develop them. The spore is smaller than the bacterium, and many are very resistant, the bacillus anthracis, which causes anthrax, being one of the worst. To be sure of disinfecting ground, where a case of anthrax has been, it is necessary to burn a fire on the spot for ten hours. All disinfection is made more difficult owing to the presence of such bacteria, and where they are known to be present must be very drastic. Fire or steam are the best disinfectants in such a case.

Question 6.—Give three bacteria which are specially advantageous to the dairy farmer?

Answer.

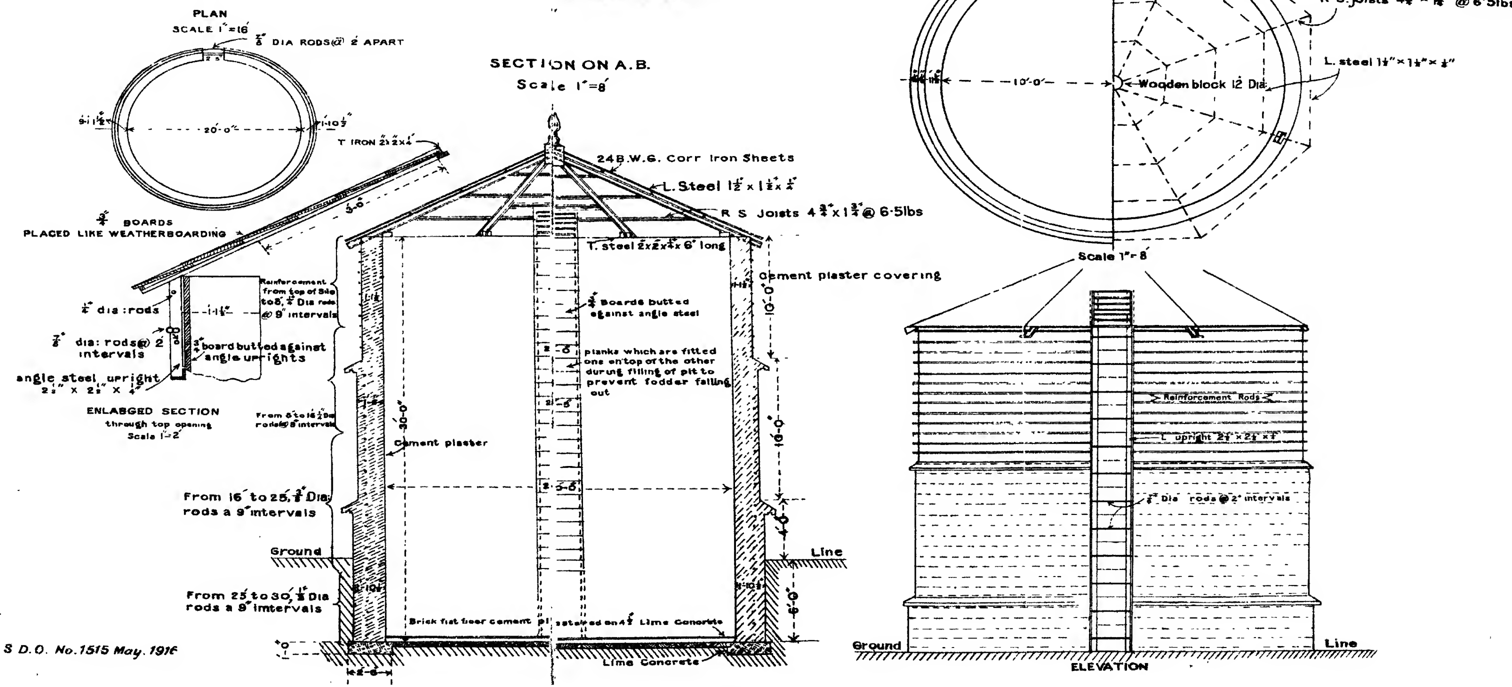
6. Three bacteria specially advantageous to the dairy farmer are—

1. The streptococcus lactecus, usually taken as the example of the lactic acid group which break down milk sugar into lactic acid.
2. The nitro-bacter of the nitrification group in soil. This completes the work of the decomposing bacteria and the nitroso-monas in changing insoluble nitrites into soluble nitrates, available as plant food.
3. The pseudomonas radici cali which form the nodules on the roots of a legume and fix the free nitrogen of the air, leaving it in the soil.

PLAN FOR

REINFORCED BRICKWORK SILO

Note:—The size of the foundation shown in the plan is intended for an ordinary station where the soil is good. At stations where the soil is not good the foundation will have to be made larger. In all cases the advice of the local Engineer Officer should be obtained as to the size and depth of the foundation necessary.



S D.O. No. 1515 May. 1916

SPECIFICATION FOR REINFORCED BRICKWORK SILO.

(1) Dimensions, diameter interval 16′, 20′, or 24′, height 30′—6′ to 10′ to be built below ground depending on the nature of the soil.

(2) Walls, to be brick in lime, $1\frac{7}{8}'$ thick for the first 10′. $1\frac{1}{2}'$ for the next 10′, and $1\frac{1}{8}'$ for the top 10′. To be reinforced with steel rods at 9″ intervals as follows :—

Feet from top of silo	Diameter in feet. 16′	20′	24′
0—8′ ...	$\frac{3}{16}''$	$\frac{1}{4}''$	$\frac{1}{4}''$
8′—16′ ...	$\frac{1}{4}''$	$\frac{1}{4}''$	$\frac{3}{8}''$
16′—25′ ...	$\frac{3}{8}''$	$\frac{3}{8}''$	$\frac{1}{2}''$
25′—30′ ...	$\frac{3}{8}''$	$\frac{1}{2}''$	$\frac{3}{8}''$

or bands may be used as at Allahabad*. The reinforcing rods to be fixed to a $2\frac{1}{2}'' \times 2\frac{1}{2}'' \times \frac{1}{4}''$ steel angle upright on either side of the opening, across which at intervals of 2′ will be carried a $\frac{7}{8}''$ diameter rod. Walls to be cement plastered inside and outside ; on the outside the plaster to cover the reinforcement Foundations of walls lime concrete.

* *Allahabad.*—Specification, diameter 18′ ; height 24′; walls brick in lime reinforced with three $3'' \times \frac{1}{4}''$ bands ; thickness $1'\ 8\frac{1}{2}''$ tapering to $1'\ 1\frac{1}{2}''$. Floor not described. Roof conical, corrugated iron, with an opening 3′ × 2′. Opening in wall 3′ wide from 8′ above ground to top ; boards closing opening fit against an angle $2'' \times 2'' \times \frac{1}{4}''$. Bottom 6′ under ground.

(3) Floor, brick flat, cement plastered, on $4\frac{1}{2}''$ lime concrete.

(4) Opening $2'$ wide in the clear, that is $2'\ 5''$ including the angle uprights. Opening to be filled in with $\frac{3}{4}''$ boards butting against the angle uprights.

(5) Roof as at Allahabad, but the opening to be in continuation of the opening in the walls, the bars across which, at $2'$ intervals, can be used as a ladder.

Note.—The provision of a roof is optional. The necessity or otherwise should be decided by local conditions and climate

The cost of a reinforced brickwork silo in accordance with the above specification will be approximately :—

	Rs.
16′ diam.	1,600
20′ ,, ...	2,200
24′ ,, ...	3,000

REVIEWS.

AGRICULTURAL JOURNAL OF INDIA, VOL. XII, PART I.

IT is with great pleasure that we notice the great though not unexpected change in the *Agricultural Journal of India*.

It now attracts the attention of both those who are not interested in cane sugar, tobacco, indigo, cotton, and wheat, and those who are. In fact it matters little what branch of agriculture one is interested in, there is something to invite perusal. This apparently has been the aim of the editorial staff, and we congratulate them on their success.

They are, however, to some extent like ourselves, not able to get the people best able to write on dairying and dairy-farming subjects, to subscribe original articles. Still we may continue to hope that the new awaking will give us a greater field to call upon in days to come.

It is very satisfactory to note that there are many other useful subjects dealt with, which are of great use to the dairy-farmer.

The section "selected articles" is a most useful one, and will assist in collecting, for the use of those interested, information that is not available without spending considerable sums on periodicals, and after all there is much valuable material existing and would be most acceptable to the lay profession.

As we have repeatedly said it is not deeply technical matter that is most needed in India at present but the more elementary information.

Finally, we consider the new volume a work for all interested in agriculture and its branches and well suited to the requirements of not only highly technical agriculturists but also of beginners as well.

LEGUMINOUS CROPS IN DESERT AGRICULTURE.

MR. ALBERT HOWARD, M.A., C.I.E., Imperial Economic Botanist, and Mr. Gabrielle L. C. Howard, M.A., Second Imperial Economic Botanist, at the Agricultural Institute, Pusa, contributed an illuminating article on "Leguminous Crops in Desert Agriculture" to the January issue of the *Agricultural Journal of India*, from which we extract the following :—

"The development of Indian agriculture is largely a problem of increasing the production of the soil. Only in this way can the country continue to support its growing population and provide the surplus wealth on which alone future schemes of development can be based. This increase in production includes the conquest of the desert by means of irrigation, a process now in rapid development in North-West India. Irrigation by itself, however, is not sufficient permanently to reclaim the desert tracts After a time, the fundamental defect in these soils—lack of organic matter—begins to tell and the produce soon falls off both in amount and also in quality. It is true that, at the beginning, surface-flooding produces large crops and that the amount of water required for the purpose is relatively small. This is largely due to the good natural aeration of desert soils. Surface flooding, however, soon destroys this, the sub-soil becomes more compacted, root-development is restricted, and more and more water is required to ripen the crop. Alkali salts also begin to appear and the general fertility diminishes. The obvious method of increasing and maintaining the supply of organic matter is by means of green manure. This is, however, a counsel of perfection as in such areas the cultivator is not likely to expend the water and labour necessary to grow green manure and also to bring about its decay in such a manner that the next crop derives the maximum advantage from this form of soil enrichment.

The problem is to discover a method by which the organic content of these desert soils can be increased, which will at the same time prove profitable to the cultivator. The solution is to be found in the extended growth of leguminous fodder-crops like *shaftal (Trifolium*

resupinatum), lucerne, berseem (*T. alexandrinum*), *senji* (*Melilotus indica* and *M. alba*), *guár* (*Cyamopsis psoralioides DC.*), which are now largely grown for green fodder round the towns of North-West India. In the Districts themselves, however, the area under these fodder-crops falls off as there is little sale for the produce in the green state and no proper methods of drying and storage exist. What the country now needs is a method of drying and baling these fodders and also a market for the dried produce. Once this is provided, the cultivation of these fodder-crops will develop rapidly and the *ryot* will then be provided automatically with a profitable means of increasing and maintaining the organic matter in the soil. Although these fodder-crops will be reaped, they leave behind a large amount of organic residue in the soil in the shape of roots and nodules and, as is well known, their cultivation involves the fixation of large quantities of atmospheric nitrogen.

Efficiency of the Ox.

The extended growth of leguminous fodder-crops solves another problem besides that of the supply of organic matter to the soil. Indian agriculture, as is well known, rests on the efficiency of the ox which is exceedingly low on account of a chronic shortage of nutritious food. The cattle engaged on the land and in transport on the roads are largely fed with substances of low-feeding value like *bhusa*, *juar* and maize stalks and with the miscellaneous chaff of the threshing floors. The amount of grain given to work cattle is small, as this substance is needed by the cultivator for food and as a source of income. The weak point in the cattle ration of India is the disproportion of albuminoids to carbo-hydrates, or, as it is expressed in works on foods and feeding, the low albuminoid ratio. Efficient and rapid work is not possible for any length of time in the case of any animal if the albuminoid ratio falls much below seventeen. As it is quite the exception to find an Indian ox provided with fodder with a ratio approaching this minimum limit, it is easy to understand that the slowness and low efficiency of this animal is, to a large extent, a natural result of poor feeding.

To obtain better and faster work the albuminoids in the food must be increased. It is of little use altering the breed, as no working animal has yet been discovered which can do the maximum work on a food of the nature of wheat *bhusa*, the albuminoid ratio of which is not more than one to thirteen. This defect in the feeding of animals in North-West India can to a considerable extent be made up without the use of grain by means of properly dried and stored leguminous fodder-crops—*shaftal*, lucerne, berseem, or *senji*. Analyses of these dried fodders disclose an exceedingly high albuminoid ratio ranging from 1:3 to 1:4. Actual feeding trials in the army at Quetta prove that working animals like horses and mules thrive on comparatively small quantities of such fodder. A mixture of from one to two parts of *bhusa* to one part of baled *shaftal* or lucerne provides a well-balanced ration to which the addition of grain is unnecessary except perhaps for heavy work.

During the last few years a considerable amount of attention has been paid at Quetta both to the enrichment of the desert soil with organic matter by the growth of leguminous crops and also to the best methods of drying and baling the produce. Although this work is still in progress, results have been obtained which clearly indicate one of the chief directions in which the arid regions of the North-West can be made to yield their maximum produce. At the same time the way has been opened for the development of improved animal production in these tracts and for the building up of a new and profitable industry in the form of the supply of baled leguminous fodders for army purposes and for the cattle employed in ordinary transport and in the cultivation of the land. The present paper deals with the progress made in these matters up to the end of the year 1916."

*
* *

Dr. Mann, Principal of Poona Agricultural College, contributes to the *Mysore Economic Journal* an article on the present position of artificial manures in India which is of special interest in view of the attention now being directed under war conditions to the importance

of increasing the output of the land. The immense importance to Indian agriculture of these manures can be illustrated by a well-known calculation. The average cereal crop-yield all over India to-day stands at about eleven bushels an acre, as against thirty bushels in England. Millions of acres in India average four bushels or less. A similar comparison holds for the yield of cotton, sugar, and other crops in this country. How serious is this deficiency in its effect on the prosperity of the *ryot*, and indeed of the whole country, is illustrated by the statement that the value of an increase over the whole grain-growing area of a single bushel per acre would suffice to pay the whole of the revenue at present needed by Government. Conditions, intellectual as well as material, being what they are, to effect this increase must necessarily be a slow process. There is, however, no doubt that could the practice of adequately manuring the soil be once firmly established the work would have been more than half performed. At present it is calculated that at least one half of India's scanty provision of natural animal manure is burnt as fuel, although the original quantity available is in any case very small by comparison with European countries, owing to the lack of stall feeding and the proper housing of cattle. The country manures, such as oil-cakes, fish and bone meal, to which the *ryot* instinctively turned, so far as he turned to anything, to eke out his supply of animal manure, have greatly increased in cost of late years as a result of primitive methods of supplying the need and the demand from tea gardens and other advanced systems of cultivation. In the circumstances, therefore, the one hope is manure in its various chemical forms, such as has worked miracles in the agricultural output of Germany, America, and the Dutch Indies. Writing in 1901 the Principal of the Agricultural School at Cawnpore remarked that "artificial or chemical manures are not practicable in India at present," while so recently as 1912 Mr. John Kenny of Poona, in his work on "Intensive Farming in India," stated with truth that the very names of the artificial fertilisers were to many in India as strange as Chinese. What progress has been made in recent years? Dr. Mann remarks that

the use of artificial manures in India has made "exceedingly slow progress." In fact, but for the fertilisers used in the planting industries of the north-east and south of the country, the quantity would be negligible. That progress is being made is evident, however, from the fact that, whereas in 1909-10 only 863 tons were imported, the total had risen in 1913-14 to 8,234 tons. This total included quantities, small but growing, of all the well-known varieties—sulphate of ammonia, nitrates of soda and lime, and nitrolim, phosphates and basic slag, and the German potash manures. Of this quantity Madras took two-thirds and Calcutta one-third. The use of artificial manures would appear still to be almost unknown in the Bombay Presidency and in Burma, although in both provinces almost untold wealth would accrue from their scientific employment. To the imports into Calcutta must be added the growing quantity of sulphate of ammonia manufactured at the coke plants at Sakchi, Giridih, and elsewhere. When the large new plant is finished at Loyabad the internal source of supply of this great nitrogen yielding manure will be larger and the promoters may be trusted to push their product even more vigorously than the Chili saltpetre importers are pushing theirs at the present moment. If they do, the result will be for the benefit of India in many ways. While the Agricultural Department and the experimental stations can easily safeguard the *ryots* against the dangers inherent in the utilisation of artificial manures, the intelligent employment of these fertilisers in proportion to the needs of the various types of soil will bring to India the greatest accession of agricultural wealth she has received for many hundreds of years.—*The Statesman.*

NEWS AND NOTES.

A "Milk Improver" Invention.

Mr. William Lawton, Secretary of the Society of Medical Officers of Health, claims to have invented a "milk improver," which he claims will convert a pint of milk, costing 3*d*., into a quart for the cost of another penny. At a demonstration Mr. Lawton described his "milk improver" as a synthetic powder extracted from grass and herbs and ordinary cattle food. To make a quart of "milk," Mr. Lawton mixes two drachms of the powder into a thin paste with cold water, pours over it a pint of boiling water, and boils the whole for five or six minutes. A pint of cow's milk is then added, and the mixture again brought to the boil, strained, and allowed to cool, when it is ready for use. The result is a quart of liquid unrecognisable in taste from ordinary milk Mr. Lawton claims that his "milk" is richer than cow's milk, and when a jugful was compared with the same amount of pure milk, it was found that a greater coating of cream was on the top of the mixture.

"My aim in composing the milk substitute," said Mr Lawton to a press representative, "is to help the housewives of England. In fact, the women worried me into doing it. The 'milk improver' is being made under my supervision by a big firm of chemical mixers, and it will be supplied to members of the Britannia League of Housewives in two-drachm packets. The 4,000 members of the League are testing the milk substitute, a week's supply of which will be provided at cost price on the receipt of an undertaking to reduce the daily milk supply by one-half, and make up the quantity with my powder."—*From "The Dairy."*

THE Bacillus Enteritidis as the Cause of Infectious Diarrhœa in Calves, K. F. Meyer, J. Traum, and C. L. Roadhouse (*Jour. Amer. Vet. Med. Assoc.*, 49 (1916), No. 1, pp. 17—35). The authors' investigations, conducted at the laboratory of the University of California, have led to the conclusion that *B. enteritidis* is responsible in the United States for certain forms of infectious diarrhœa in calves. It is pointed out that our knowledge concerning *B. enteritidis* and paracolon infections, especially in bovines in this country, is very limited. While the observations do not permit definite conclusions as to the prevention and treatment of infectious diarrhœa of calves after the first few days of their lives, they do, however, suggest that when milk of an unknown quality is fed it should first be pasteurized. "Symptomatic treatment is as a rule not satisfactory and not much can be expected from either serum or serum and bacterin treatment unless the specific organism is employed in the production of these biologic products."

*
* *

EXPERIMENTS in Sweden on the Prolonged Pasteurization of Milk, C. Barthel. Trials with the "holder" process of pasteurizing conducted in Sweden have proved very satisfactory. It was found that milk pasteurized for from 20 to 30 minutes at 145°F. has no "cooked" taste, although this becomes noticeable at 149°. The cream also rises as readily in milk pasteurized at 145° as in unheated milk, but after pasteurizing at 149° it rises more slowly. Heating to 145° does not affect the protein or the soluble phosphates, but here again the influence of a temperature of 149° begins to make itself felt. The enzymes remain intact at 145° with the exception of amylase, which is destroyed at a relatively low temperature.

The experiments showed that pasteurized milk keeps from one to two days longer than ordinary milk, according to the temperature at which it is kept. The effect of pasteurization in destroying bacteria is also very satisfactory. When the milk after being heated is reinfected by the ordinary lactic ferments it becomes

acid in the usual way, but naturally more slowly than unpasteurized milk.

The prolonged pasteurization of milk as carried out in the dairy industry, *viz.*, heating for from 20 to 30 minutes at from 140 to 147·2° in apparatus maintaining it in continual motion, is deemed sufficient to remove all danger of the conveyance of tuberculosis by means of milk.

***

Concrete Mixtures.

The following mixtures are recommended by the Portland Cement Association, the figures representing volumes of cement, sand, and pebbles or broken stone. Thus, a 1 : 2 : 3 mixture means 1 sack (1 cubic foot) of cement, 2 cubic feet of sand, and 3 cubic feet of pebbles or broken stone.

1 : 1 : 1 Mixture for—

- The wearing course of two-course floors subject to heavy trucking, such as occurs in factories, warehouses, on loading platforms, etc.

1 : 2 : 3 Mixture for—

- Reinforced concrete roof slabs.
- One-course concrete road, street, and alley pavements.
- One-course walks and barnyard pavements.
- One-course concrete floors.
- Fence posts.
- Sills and lintels without mortar surface.
- Watering troughs and tanks.
- Reinforced concrete columns.
- Mine timbers.
- Construction subjected to water pressure, such as reservoirs, swimming pools, storage tanks, cisterns, elevator pits, vats, etc.

1 : 2 : 4 Mixture for—

- Reinforced concrete walls, floors, beams, columns, and other concrete members designed in combination with steel reinforcing.
- Concrete for the arch ring of arch bridges and culverts; foundations for large engines causing heavy loading, some impact and vibration.

Concrete work in general subject to vibration.
Reinforced concrete sewer pipe.

1 : 2½ : 4 Mixture for—

Silo walls, grain bins, coal bins, elevators, and similar structures.

Building walls above foundation, when stucco finish will not be applied.

Walls of pits or basements, subject to considerable exposure to moisture but practically no direct water pressure.

Manure pits, dipping vats, hog wallows.

Backing of concrete block.

1 : 2½ : 5 Mixture for—

Walls above ground which are to have stucco finish.

Base of two-course sidewalks, feeding floors, barnyard pavements, and two-course plain concrete floors.

Abutments and wing walls of bridges and culverts, dams, small retaining walls.

Basement walls and foundations for ordinary conditions where water-tightness is not essential.

Foundations for small engines.

1 : 3 : 6 Mixture for—

Mass concrete such as large gravity retaining walls, heavy foundations and footings.

1 : 1½ Mixture for—

Inside plastering of water tanks, silos, and bin walls, where required, and for facing walls below ground when necessary to afford additional protection against the entrance of moisture.

Back plastering of gravity retaining walls.

1 : 2 Mixture for—

Scratch coat of exterior plaster (cement and stucco).

Facing block and similar concrete products.

Wearing course of two-course walks, floors subjected only to light loads, barnyard pavements, etc.

1 : 2½ Mixture for—

Intermediate and finish stucco coats.

Fence posts when coarse aggregate is not used.—*From "The New Zealand Dairyman."*

Some Lime and Acidity Pointers.

Lime, like sulphur, is winning recognition among the "critical elements"—nitrogen, potash, and phosphorus. It is equally as essential to plant life and growth as the latter. It is not exactly a plant food, neither is it a true fertiliser, therefore we call it an "indirect fertiliser," because it checks the loss of important elements, if they happen to be in a form liable to be leached away; and on the other hand, it releases these same elements in case they are held so intact that plants cannot get them.

Lime, itself, is not to any great extent subject to leaching because water cannot dissolve much lime The large depletion is due to the removal of crops. The seed carries little lime but the plant as a whole carries much, hence sooner or later soil acidity is the result.

The following figures will give some idea of the rate of depletion due to cropping: 30 bushels of wheat rob the soil of about 15 lbs. of lime; 80 bushels of maize rob the soil of about 15 lbs. of lime; 6 bushels of peas rob the soil of about 15 lbs. of lime; 15 bushels of flax rob the soil of about 15 lbs. of lime; 2 tons of clover hay rob the soil of about 75 lbs. of lime.

Is it any wonder that the soil becomes depleted of lime if left to hay, or is it any wonder that most soils need lime to successfully grow clover, lucerne, and other legumes, the heaviest lime feeders on the farm?

***

Response of Different Crops to Lime or Acidity.

Soy beans, cowpeas, peas, beans, clover, lucerne, vetch, and all legumes are stunted, yellow, and sickly in soils low in lime and practically refuse to grow successfully in such soils. The same crops grow wonderfully in a lime soil.

Potatoes, millets, red top, and some grasses do well on a slightly acid soil.

***

Chemical and Physical Benefits of Lime.

As previously stated, the chemical effect of lime is to hold elements liable to loss and also to release very

intact elements. Lime also forms compounds with desirable elements, thereby preventing less desirable compounds that might be formed. It also neutralises injurious humic acids.

On hard, compact soils that have a tendency to "puddle," lime has an excellent physical effect. It flocculates the particles forming a loose, porous soil permitting of aeration and drainage, resulting in a better plant growth.

The writer conducted an experiment of this sort on a piece of ground known to have been cropped to hay for years until its acidity was extreme. Slacked lime from a tannery refuse was applied at the rate of about five tons to the acre owing to a lower percentage of lime in this material.

The previous year the crop was a failure. In the face of a late season and extremes of rain, this ground produced cowpeas that were six feet tall, soy beans that stood above a man's hips, and maize that was of a deep green colour, having strong stalks and large, well developed ears. Contrary to custom, the lime was not applied weeks before planting but a few days before, and was well disced in. In accordance to claims, the results were not beneficially apparent with potatoes. It did as expected. The potatoes seemed to be burned in spots. The conclusion was that the benefits would have been better had the lime been applied weeks before. The results remain to be seen another year from a chemical standpoint. The physical effect was very noticeable. The soil was open and porous and the beneficial results, no doubt, were mostly due to the physical effect.

A small patch of lucerne was tried on this soil and made a wonderful start.

*
* *

How to test for Lime and Acidity.

Hydrochloric acid is commonly used to detect the presence of lime in soil. To familiarise one's self as how it should act in case there is lime in the soil, drop a piece of lime or limestone in dilute hydrochloric acid and note the bubbling effervescence. A small sample

of soil when tested with the dilute acid will produce bubbles : in the absence of lime, no bubbles will escape. This is a fair and practical test.

If the soil is acid when moistened it will turn blue litmus paper pink and produce no effect on pink litmus paper. This test is not to be relied upon to any extent. It is enough to interest one and if the soil shows acidity it would be advisable to send a sample to the experiment station for a more accurate test.

Then, the presence of sheep sorrel, sour dock, and mare's tail is claimed to produce acidity. This is not to be relied upon too much, for these weeds grow on lime soils and soils that have been heavily limed. Let them arouse interest, but seek a more reliable test for soil acidity

The question of soil acidity is very important ; but to say the least, it is mighty confusing. In "The Great Stanley County" of Wisconsin we maintain that we grow the greatest grass and clover in the whole country, and no one can dispute our claim. In fact, clover grows anywhere the seeds are sown ; in fields, cut-over land, or underbrush and trees wherever there is a peep of sunshine. And still the acid and litmus paper tests show us that the lime content or acidity is questionable on much of the surface soil which is a silt loam. The subsoil carries more lime. Weeds, that indicate acidity, grow on this same soil. Authorities claim that blackberries grow best on an acid soil. In our forests blackberries grow like tame ones, and by the bushels. They say that indicates acidity, but right beside the berries is the clover, nowhere to be beaten. That tends to confuse. If clover grows well we claim no acidity, but lucerne in this same country is not so successful. Even if it were, we have no need for it, but, on the other hand, our clay subsoil may be the factor that works detrimentally to our lucerne. The point to be made is that acidity is confusing.

***

Kinds and Amount of Lime to apply.

Finely ground, raw limestone rock is generally favoured and should be applied of the rate of $1\frac{1}{2}$ to 2 tons

to the acre, depending upon the acidity and per cent. of pure calcium oxide in the rock.

Burned or caustic lime is not so preferable for many reasons. It has a burning effect on the humus content of the soil. This would be very detrimental on a sandy soil, but on the other hand would make it preferable on a peaty or mucky soil. About one-half of the amount should be used as recommended for the raw limestone.

Slacked lime is commonly used and should be used at about three-fourths the rate of raw limestone.

Wood ashes are excellent for soil, especially when placed under fruit trees. Ashes contain as high as 50 per cent of lime besides much magnesia and potash, andmake a good topdressing. Care should be exercised so as not to spread too thickly. Farmers would do well to contract for wood ashes where there is any large quantity produced.

Phosphate rock contains lime, but the application is expensive if there is no pressing need for phosphorus.

Gypsum is by no means as desirable as the above forms of lime. It does serve a valuable purpose if sprinkled on the barn floors near the drop to preserve the ammonia released from liquid and solid excreta of animals. An application to the soil in this form is fine, but to apply otherwise is apt to leave traces of acidity.

Marl and air slacked lime are very similar, both being fine and light. The clay contained in marl makes it easy to handle, and the mixture is certainly recommended for sandy soil. Lime itself will give sandy soil a better water holding capacity and its union with clay will be still more beneficial.

***

When and How to apply Lime.

As a topdressing for sods, lime may be applied in spring or autumn, preferably in the autumn. On other land it is desirable to apply the lime early enough to allow several weeks for the lime to act with the soil.

Lime should never be applied just before planting potatoes and beets, as their quality will be lowered.

Neither should quicklime be applied with manures or fertilisers, as it reacts detrimentally with the nitrogen.

There are a number of ways to apply lime to soil. Some use a manure spreader, special lime spreader, fertiliser distributor, or spread by hand. Not all manure spreaders will spread lime successfully. The most desirable spreader is that having a return apron, worm and gear drive, with a cylinder set in the box directly over the apron. Some sort of hood should be provided at this point to prevent blowing and insure a uniform spreading on the ground.

Spreading lime from waggons with shovels is very unsatisfactory. The result is sore hands and injury to harness and all concerned. It is preferable to put the lime in piles, the size and distance apart depending upon the rate of application per acre. One ton per acre requires 50-lb. heaps about 34 feet apart. For two tons put 100-lb. piles at the same distance. To arrive at some idea of weight, consider a bushel of stone lime as 85 lbs. The same slacked would weigh about 160 lbs.

Influence of the Weather on Milk.

The influence of the weather upon animals and animal products has always been a subject of interest. In particular some investigations have been conducted with the view of ascertaining how animals may be protected from chill. Experiments carried out in recent years show that the falling off in milk supply from cows lying out is little or none as compared with those kept constantly tied up, provided the animals are well fed and reasonable shelter is found. Animals which are allowed exercise get up a healthy circulation which enables them to withstand chills, and if they can get rough shelter they adapt themselves to the winds. Animals tied up in undue warmth during part of the twenty-four hours, and standing in cold draughts, such as are found in many cowsheds, are in a more defenceless condition. Ventilation and draught practically always go together and do not work harmoniously for the animals. Animals stand great cold with impunity so long as they can get under shelter to keep their skins dry, and can lie dry. It is

the evaporation of moisture from an animal that causes chill, and consequently the necessity for sheltering sheds in lands and pastures. When topping-up fattening cattle there is no doubt that meat is more quickly laid on when they are restricted in their movements; but in doing this the ultimate object is not in maintaining a healthy constitution for a lengthened period.

It is not to be inferred from what has been said that animals should be left to face the full brunt of wet and wind, snow and frost; and the amount of shelter needed depends very much on the breed, and whether it is in its natural climate. Food, however, is the great defender from cold, and the colder it is the more is needed. A well-filled stomach, even though it be of coarse food with little food material, seems to act as a protection against cold, the bulk of warm substance acting as an inner lining against loss of temperature; but the increase of cold should be met by additional starchy or fatty matter, which, when assimilated, will generate heat. The well-known experiments on pigs carried out many years ago by Sir John Lawes showed what a large proportion of the food consumed went to maintain respiration, to which starch and oils mainly contribute.—*The Dairyman.*

***

Food Effects on the Quality of Milk.

Some recent experiments conducted by the authorities at Cambridge corroborate what most dairy farmers have long known, and the present writer has preached for the last twenty-three years—*viz.*, that while food affects the quantity of milk yielded by a cow it does not affect the quality as shown by analysis. So long as the health of the cow is not deranged the food has little effect, for, while a change may influence the milk for a day or two, the cow returns to her "normal" very quickly. Even very succulent grass does not reduce the fat or other solids in the milk unless the animal scours—an unhealthy condition—and a pound or two of cake daily will correct this. Even the use of wet brewer's grains, which are reckoned to stimulate a flow of poor milk, when tried at Cambridge actually raised the fat by a

fraction. In other words it is impossible to "feed water" into the milk, as some of our milk prosecutors allege. The reason for all this was first explained just twenty-three years ago by Professor Henry, of Wisconsin University. He pointed out that a cow naturally yielded milk for the purpose of feeding her calf, and it was a wise provision of Nature which made the composition of this remain constant, or only vary within narrow limits, no matter what kind of food was eaten by the mother. Those who have had to do with the feeding of calves know how easily the stomach of such is upset by any change of food, and thus under ordinary conditions the milk does not readily fluctuate. It is a pity that these matters are not known to magistrates and medical officers of health, and others who have to do with milk prosecutions. Some of them seem to think that farmers can control the milk composition, and assert that dairymen deliberately try to produce poor milk—a result absolutely beyond their power, even if it were any use to them.—*The Dairy.*

*
* *

Lime on Grass Land.

The nutritive value and palatability of grasses are improved by applications of lime to grass lands. The grasses and herbage are rendered more nutritious, and the flesh and bone-forming materials promote thrifty, healthy animals.

The strange and depraved appetite of cattle which chew bones is induced by a deficiency of lime in the soil. The disease known as "cripples" in cattle is brought on because the bone-forming material is absent in the grass and herbage, through a deficiency of lime in the soil. In calcareous zones, that is, in districts where there is an abundance of lime, cattle never exhibit this highly objectionable habit, and the disease known as "cripples" is confined to districts where the deficiency in lime is very pronounced.

One ton of lime per acre, applied to the pasture land, will give results far exceeding the amount expended. Dairy farmers, and stock-owners generally, can, by making use of this new factor in production,

greatly increase the stock-carrying capacity of their holdings.

***

Cheapening the Cost of Milk.

No feature in connection with the increased cost of living to-day has aroused such hostility as the rise in the price of milk. The interests responsible for this development maintain that it has been forced upon them as a result of the enhanced cost of feeding-stuffs and the increase of wages which they have had to meet. But the British farmer is the most conservative member of his class in the world. As a rule, time-saving, labour-saving, money-saving devices make no appeal to him. This is clearly seen in connection with the suggested adoption of mechanical milking methods. In peace-times, when labour was cheap and plentiful, his hostility to mechanical methods triumphed; but under the present conditions this antagonism is meeting with public denunciation. That the farmer is in error has been plainly proved, and it is not improbable that the absence of skilled hand-milkers will in the end compel him to introduce mechanical devices. It has been clearly shown, in the case of farms worked upon up-to-date lines, that cows may be milked in far less time, more efficiently, and at less cost by machine than by hand. In one case a mechanical milker is now doing the work which formerly required the services of five hand-milkers. The installation is capable of milking eighty-five cows simultaneously, and the cost of operation is but a mere fraction of that formerly incurred. In this instance electricity being available from the public supply system, it is employed to drive a one and a half horse-power motor actuating the vacuum-pump, the pipes from which extend to the machines disposed in the stalls. Apart from the saving of time and money, there is no risk of the milk being contaminated by coming in contact with the hands. During the past few years the mechanical milker has undergone considerable improvement and development. Several excellent machines are now on the market, and there is every reason to hope, under the pressure of

labour shortage, that this modern method of milking cows will come into general vogue, which will certainly conduce to the greater purity and cheapness of our milk supply.

***

Taking off a Horn

In the case of an accident.

A dairyman, one of whose cows broke its horn, was told by his neighbours that he could have stuck the horn in place again instead of cutting it away, as he did. He asked a farm journal what he ought to have done, and received this reply :—

It is only in very rare instances when horns are broken that fixing them on again is successful. In most cases the separation is too complete for the parts to reunite, and generally the best thing to do is to take them off. To stop the flow of blood, which is in most cases profuse, a pad of tow or cotton-wool soaked in carbolic oil should be applied and kept in position with a bandage. Over the pad should be smeared a layer of tar, and another bandage, attached to the other horn, should be bound over this one.

***

The Sire.

A good male should head the herd. If heifer calves worth while are to be raised to replenish the herd, a poor bull is more expensive in the long run than a few poor cows, and should not be taken as a gift. No one can afford to use a "scrub," and no progressive dairyman will use one. The kind of bull used advertises the energy and intelligence of his owner. It is wise to avoid buying even heifers from the man who uses a "scrub" bull, or a bull of beef breeding.

The problem of selecting a good sire is not always an easy one. At the present time the majority of breeders do not keep accurate records of the production of their cows, and hence are not able to give accurate information to purchasers of their bull calves. It sometimes happens that bulls from high producing dams fail

to transmit this quality to their offspring, but they are much more likely to do so than bulls from low producing dams. In using young bulls this risk must always be taken. For this reason it is especially important that one looks carefully into the records of the dam and the sire's dam before purchasing. When possible, it is desirable to purchase an aged bull which has proved his merit by the high production of his daughters, provided he is in good health. The majority of men object to handling aged bulls because often they are vicious. For this reason few bulls are kept until their heifers are in milk and their productive capacity determined. Until this time the sire's real value is unknown. Many a good bull which would have made his owner famous has been slaughtered at an early age.

The selection of the herd bull is of the greatest importance because he is at least half the herd from the breeding standpoint. His influence on the characteristics of every calf born in the herd is as great as that of the dam of the calf; and, if he is a pure bred animal used on grade cows, his influence will be more than half because his transmitting powers in breed characteristics will be stronger. No bull whose dam and paternal grand-dam were not capable of producing 300 pounds of butterfat in 365 days should be used for breeding purposes. It would be much better if this minimum were set at 350 pounds. The wise dairyman will select from a cow, which produced above 400 pounds. If the use of bulls from dams and paternal grand-dams which produced less than 300 pounds of fat could be prohibited by State law it would a long stride in advance.

***

New Zealand Dairyman.

Champion Cows of Each Breed.

("Hoard's Dairyman.")

For the information of our readers we give below the names of the cows of each breed holding the highest semi-official yearly records in their several classes, these records being correct to 1st January, 1916, according to

the secretaries of the several breed associations. This report is worthy of preservation, and we would suggest that it be cut out and pasted in the herd book or some other books of convenient reference. In this way it will be easy to note changes of placement as new records are made.

Where both the milk and fat records are not held by the same cow, each cow holding these records is given under her appropriate class in the following tables :—

AYRSHIRE.

Class.		Name.	Milk lbs.	Fat lbs.
5 yrs. and over	...	Garclaugh May Mischief ...	25,329	894·30
		Lily of Willowmoor ...	22,596	955·56
4½ to 5 yrs.	...	Miss Nox 3rd ...	15,015	576·94
4 to 4½ yrs.	...	Agnes Wallace of Maple Grove	17,657	821·45
3½ to 4 yrs.	...	Elizabeth of Juneau ...	15,122	536·15
		The Abbess of Torr ...	14,582	640·72
3 to 3½ yrs.	...	Ethel of South Farm ...	15,056	589·20
2½ to 3 yrs.	...	Henderson's Dairy Gem ...	17,974	738·32
2 to 2½ yrs.	...	Jean Armour 3rd ...	14,987	599·91

BROWN SWISS.

Mature	...	College Bravura 2nd ...	19,461	798·16
5 yrs. old	...	Rosalind B. ...	16,804	727·64
5 yrs. old	...	Ethel B ...	17,343	710·99
4 yrs. old	...	Merry of Allynhurst ...	14,371	578·87
3 yrs. old	...	Kundry ...	14,087	574·52
3 yrs. old	...	Ila B. ...	15,603	548·92
2 yrs. old	...	Elsie of Lake View ...	13,149	486·91

GUERNSEY.

5 yrs. and over	.	Murne Cowan ...	24,008	1098·18
4½ to 5 yrs.	...	Dairymaid of Pinehurst ...	17,285	910·67
4 to 4½ yrs.	...	Azucena's Pride 2nd ...	16,204	855·70
3½ to 4 yrs.	...	Dolly Dimple ...	18,459	906·89
3 to 3½ yrs.	...	Johanna Chene ...	16,187	863·36
2½ to 3 yrs.	...	Langwater Hope ...	15,079	773·59
2 to 2½ yrs.	...	Cherry of Edgewater ...	13 454	732·97
2 to 2½ yrs.	...	Marshall's Lady Dudley ...	14,814	606·46

HOLSTEIN-FRIESIAN.

5 yrs. and over	...	Duchess Skylark Ormsby ...	27,761·7	1205·09
5 yrs. and over	...	Tilly Alcatra ...	30,451·4	951·23
4½ to 5 yrs.	...	Lucile Jolie Pontiac ...	23,830 2	938·52
4½ to 5 yrs.	...	Irma Gilt Edge Queen 2nd ...	26,745·3	758·88
4 to 4½ yrs.	...	Daisy Grace De Kol ...	21,718 3	962·80
4 to 4½ yrs.	...	Queen of the Hengervelds ...	23,788·1	702·46
3½ to 4 yrs.	...	Dutchess Hengerveld Korndyke	22,897·0	903·38
3½ to 4 yrs.	...	Friend Echo Elnora ...	23,148·6	732·70
3 to 3½ yrs.	...	Finderne Holingen Fayne ...	24,612·8	1116·05
2½ to 3 yrs.	...	K. P. Manor Kate ...	22,106·4	818·73
2 to 2½ yrs.	...	Finderne Mutual Fayne ...	22,150·4	960·51
2 to 2½ yrs.	...	Elmside Nuidine Segis Johanna	22,802·3	706·40
Under 2 yrs.	...	Woodcrest Colantha Pietje ...	20,859·7	639·62

JERSEY.

Class.		Name.		Milk lbs.	Fat lbs.
5 yrs. and over	...	Sophie 19th of Hood Farm	...	17,557·7	991·1
5 yrs. and over	...	Passport	...	19,694·8	839·3
4½ to 5 yrs.	..	Olympia's Fern	...	16,147·8	937·8
4 to 4½ yrs.	...	Lass 64th of Hood Farm	...	13,444·6	817·8
4 to 4½ yrs.	...	Flying Fox's Maid	...	14,315 6	785·9
3½ to 4 yrs.	...	Lass 66th of Hood Farm	...	17,793 8	910·6
3 to 3½ yrs.	...	Lass 74th of Hood Farm	...	13,713·9	747·6
3 to 3½ yrs.	...	Lucky Farce	...	14,184·8	708·5
2½ to 3 yrs.	...	Lad's Lady Riotress Irene	..	12.307 8	660·8
2 to 2½ yrs.	...	Pearly's Exile of St. Lambert		12,345·5	816·1
2 to 2½ yrs.	...	Lass 66th of Hood Farm	...	14,513·1	720·5
Under 2 yrs.	...	Lucky Farce	..	14,260·0	635·8

*
* *

Treatment for Lumpy Milk.

If the cow gives stringy or lumpy milk the probability is that this is a case of mammitis or garget. There are several treatments for this, depending largely upon the cause. It might be caused from internal injury or from the cows lying on the cold ground. In such instances either hot or cold fomentations are excellent. Again, it might be caused from feeding too much grain or from the cows catching cold from exposure. In such cases half an ounce of saltpetre at a dose three times a day for three days in bran mash and followed with epsom salts, one and one-half pounds at one dose dissolved in half gallon of cold water is advised. Very often garget becomes a chronic disease and when it does it is difficult to cure. If a cow had become in this condition when she dried off again she ought to be disposed of.

*
* *

Calf Scours.

I think I have the best remedy for calf scours I ever heard of, and it may be useful to some of your readers. I put from one teaspoon to two tablespoonfuls of ground ginger in the milk, depending upon the age of the calf and conditions. In addition, I always cut down the quantity of feed one-third to one-half, and begin with a small dose. This increases the hunger of the calf and makes him less particular, while the smaller feeds are better for the disordered stomach.

I have had all kinds of calf scours to contend with—one calf having two hard fits. This one I gave two good doses of castor oil and laudanum, and then followed up with ground ginger in small feeds. I frequently break off feeding whole milk abruptly, and if the calf is doing well seldom go over ten to twelve days for changing, and often begin adding a little corn meal or commercial calf meal to the feed when the calf is two weeks old. At from two to two-and-a-half months my calves as a rule can digest anything from whole milk to grass burrs. One has to be governed by the condition of the calf. Some calves are much more hardy than others, and by all means don't overfeed.—S. W. B., in *Hoard's Dairyman.*

***

The Over-run Explained.

Commercial butter consists of pure butter-fat 82 per cent., water 15 per cent., salt $2\frac{1}{2}$ per cent., ash $\frac{1}{2}$ per cent. By the Babcock test the farmer gets paid for the pure fat in the milk only. The balance of the ingredients in the butter—the water, the salt, the ash, etc., is known as "the over-run." In the old days, when New Zealand's dread middlemen, Stupidity and Ignorance, Unlimited, ruled the roost, we used to make a butter containing five, six, or seven per cent. of water, and this is the reason why to-day abnormal over-run of seventeen to eighteen per cent. seems to be got by "faking the test." Is this plain enough?

***

The New Zealand Dairyman.

Notes on Liming.

Of the many different foods necessary for healthy plant life, lime occupies a position of considerable importance; and although crops can be, and are, grown on soils sadly deficient in lime, the quantity and quality of the produce so grown will not be as great nor as fine as if there had been no lack of this sweetening and ameliorating plant food. Land containing less than 0·3 per cent. of lime in the form of carbonate cannot produce

its full quota of crops, for the important reason that the crops cannot make the utmost use of the dung or artificials present without the help of lime.

The application of lime on land deficient—and there is a good deal of land that would respond to lime—will assuredly increase the crops, especially turnips, swedes, wheat, oats and clover; potatoes, in my experience, are the only crop that don't care for a direct application of lime. In fact, giving lime to potatoes injures them, causing them to be scabby; and it diminishes the yield. Put lime on the potato land after they are dug, or in the spring; the wheat crop and the clover will benefit very greatly. Lime stiffens the straw of all cereal crops, and adds to the weight and yield of grain. I believe in applying lime in small doses when growing corn crops; not more than 10 cwt. per acre of burnt or caustic lime per annum. The influence of large dressings of lime is very marked the first year after appplication; but its influence decreases with each successive year. I regard large dressings on arable land as unwise unless there is a tremendous deficiency. Of course on land that has not had any lime for a great number of years a heavy dressing may be advisable. Some men advocate ploughing lime in, but I favour putting it on after the land has been ploughed. It mixes, and becomes incorporated better so. Lime always had a tendency to sink in the soil; and through percolation and drainage by rain there is a considerable loss of lime from the soil annually. This loss will vary according to the texture of the soil.

It should be borne in mind that a small dressing of lime uniformly distributed by a manure sower is far more effective in proportion than a dressing that has been put in small heaps over the field and spread with a shovel. I like ground-burnt lime or home-slaked lime better than ground limestone. If you choose the latter you apply a larger quantity; that is all there is in it.

I do not think that gas lime is as highly appreciated as it ought to be. Where a farmer is near a gasworks he should take advantage of the efficacy and cheapness of this material. He can cart it into a large heap to oxidise, after which it will give profitable returns if applied in larger quantities than burnt lime. It will drive

wireworm, but I do not think it kills them. The most striking example of the effect of lime on sour pasture I have ever seen occurred in an adjacent park. The herbage was of an indifferent character; the cattle would scarcely touch it The owner gave it such an extremely heavy dressing that the grass in many places was burnt entirely off. However, in time it recovered, and now the park land is as green as a leek, and grazed as bare as a billiard table. In conclusion, there should not be much difficulty in ascertaining if a field wants lime. The weeds generally indicate this. A lot of common sorrel and snake-weed are, in grass fields, a sign of a deficiency of lime, whilst on arable land spurry, yellow marigold, and the small creeping sorrel are also indicative of a serious need of lime. On such land there is ever a danger of that nasty disease, finger-and-toe, in one's swedes or turnips.

Lime is needed to correct acidity, to help the other manures to work and to keep the soil in a healthy condition.—*Calcium Oxide.*

***

"Scatter Plenty o'er a Smiling Land."

During the last few months there has been much talk of introducing radical land reforms, which, in the exuberant language of prominent politicians, will "scatter plenty o'er a smiling land," and such optimism—calculated optimism may we say—certainly raises a smile on the face of practical men who know that a "get-rich-quick" policy is not likely in agriculture to lead to the anticipated results.

Land reforms of the right kind are not to be deprecated, but farmers may well say "save us from our friends," if so-called reforms are to be translated into an Act without being first subjected to careful consideration.

By the force of natural laws, more powerful than legislation, agriculture has got out of the deep rut of depression, in which it stuck for so long, and is advancing gradually and surely to greater prosperity. The era of cheap food, sold below the cost of production in this country, has passed away, not to return, because

the populations of the world have increased at a greater rate than the world's food supplies; hence the cry of statesmen, alarmed at the effect of high prices on the minds of the people, that "the land must produce more," "the best use must be made of the soil," and so on.

Well, the farmers of Great Britain are quite ready to do their share, and they will be successful, if encouraged, by fair legislation. In justice, however, to the farmers of this country, it may be pointed out, as the President of the Board of Agriculture has admitted, that already they produce the best stock and the best crops in the world—and they are still going ahead.

Science is being applied to soil cultivation, the use of fertilisers, the rearing of stock, and it may be said that the farmers are taking as their guide the motto, "Practice with Science."

It is generally recognised that the intensive cultivation of the soil has become a necessity, and that to enable this system to be pursued with success, it has equally become a necessity to restore to the soil the plant food extracted from it by the harvested crops. The nature of these plant foods has been studied, and every intelligent farmer knows that he must purchase it in the forms of nitrate of soda, sulphate of ammonia, guano, potash salts, superphosphate, basic slag, and similar fertilising materials, in addition to supplies of farmyard manure. He knows that to starve the soil is as bad a policy as to starve his cattle, and that only by a judicious outlay on fertilisers and feeding stuffs can he hope to make the most of his soil and realise a reasonable profit for his trouble and expenditure.

And if farming is conducted at present on a more scientific system than twenty years ago, who would venture to foretell what fresh great advances may be before us? We may stand on the threshold of discoveries capable of producing results of a nature which would to-day seem marvellous.

Agencies to-day dimly comprehended may serve as the handmaiden of agriculture to increase the productiveness of soils, and to enable economists and statesmen to view the multiplying of the people without the shadow of a food famine before their eyes.

The future of agriculture is the future of civilisation, and farmers may feel proud of belonging to a vocation, the most important as well as the oldest in the world.—*Farmers' Red Book.*

*
* *

Pasteurised Milk and Scurvy.

Dr. Emmet Holt, at a recent meeting of the New York Academy of Medicine, claimed that all infants fed on pasteurised milk developed scurvy, which varied in its manifestations from an almost unnoticed to a most positive condition. A number of control infants, fed exactly on the same milk but with the addition of a little orange juice, were entirely free from any scorbutic symptoms, and of those who developed the disease every one promptly recovered on the administration of orange or lemon juice. So serious was the spread of the infantile scurvy that the New York authorities were forced to take immediate action in the matter, and it is interesting to relate that the energetic advertisement of the evils attending the use of the milk without a concomitant use of anti-scorbutic remedies resulted, in one week, in the almost total disappearance of the disease. The health authorities are satisfied that the use of pasteurised milk is safe enough to be continued, provided, however, that orange or lemon juice be administered at the same time.

*
* *

A Good Excuse!

Cows and Zeppelinitis.

Recently at a London suburban police-court a milk dealer, who was summoned for selling milk containing added water set up the defence that the cows were in a district which had been attacked by airships, and in consequence the milk had been considerably affected. An expert witness said it was quite possible that abnormal milk would come from cows suffering from fright. The Bench dismissed the

summons in view of the exceptional circumstances, and summonses against two other milk dealers were also dismissed.

***

The Value of Bran.

We do not seem to realise to a proper degree the feeding value of what is known under the general name of wheat offal—that is, the by-products from wheat in the manufacture of flour. These go under various names in various parts of the country, and vary also according to the particular kind of by-product. We accordingly meet with such designations as middlings, thirds, parings, sharps, seconds, medium bran, broad bran, and so on. The outstanding feature about them generally is their comparative cheapness. In the lists now issued periodically by the respective Boards of Agriculture, in which the values of all the commoner purchased foods are worked out to "unit" values, it is shown that these foods are among the lowest in the scale of cost in the matter of feeding value, and there is every inducement to use them largely where suitable. It is pointed out that in the case of bran in particular its capabilities as a fattening food, and also as a working food, have never been fully realised, and that it ought to be more largely employed for fattening bullocks, feeding horses, making milk, and so on. Our Continental competitors have long been aware of this, and so the bulk of the home product was exported before the war. It has now to be largely kept at home, and we would be wise to take advantage of its comparative cheapness. This cheapness may be illustrated by pointing out that it costs only two-thirds the price of common cotton-cake and three-fourths that of bean meal on the feeding scale. A curious point about the feeding of bran should be noted, and that is that it gives the best results when fed dry.

***

Dairy Education.

Dairy education is not a goal, it is not the end sought; it is a tool to be used in attaining the desired

end, and just as some can not drive a nail without marring the wood or even saw a board straight, so some may never profit by education.

Education is training the eye to see, to read, and the mind to think and draw right conclusions from conflicting data and evidence. But education is not only training ; it is profiting by the experience of others ; it is avoiding the experimental period, the cutting and trying and proving a truth that has already been proved and demonstrated many times over. It accepts that which is proved.

The ancients knew that to keep milk sweet it must be cold. Science has shown us why, and the very beginner in the business of dairying can learn what temperature is necessary to secure the keeping of milk ; he can learn whether or not he has that temperature, and know that given that temperature, the milk received in the right condition will keep. Education then is but the tool that enables him to secure this information and profit by it immediately. The young man who expects to rise to a position of responsibility and individual independence, who hopes to have his own business in any branch of the great dairy industry, can afford to add to his natural endowment and practical experience the help that comes with systematic training.

DAIRY EDUCATION ASSOCIATION.

..........................191 .

THE HON. SECRETARY,

DAIRY EDUCATION ASSOCIATION,

(INDIAN BRANCH),

85, *Survey Road,*

QUETTA.

Dear Sir,

I wish to become a member of the above Association, and if elected agree to promote the welfare of the Association to the best of my ability and to remain liable for my subscription until I shall notify the Hon. Secretary of my resignation. On receipt of your letter advising me of my enrolment as a member, I will forward the subscription of Rs. 5 to the Hon. Secretary (Mr. H. J. Riddick, 85, *Survey Road, Quetta), and yearly on October 1st, or otherwise accept the 1st issue of the Journal by V.-P. P.*

Dairy School or Schools attended and length of time of instruction.

....

....

Dairying Certificate, Diplomas, etc.

....

....

(Signed)..

Mr., Mrs., or Miss, etc.

Permanent Address...

....

VOL. IV, PART IV. QUARTERLY. JULY, 1917

THE JOURNAL OF DAIRYING

AND

DAIRY FARMING IN INDIA

DAIRY EDUCATION ASSOCIATION

D. E. A.

Printed by Thacker, Spink & Company, 6, Mangoe Lane, Calcutta, and
Published for the Committee, Dairy Education Association in India.

CONTENTS

THE

JOURNAL OF DAIRYING

and

Dairy Farming in India.

VOL. IV.—PART 4.] QUARTERLY. [JULY, 1917.

EDITORIAL.

THIS edition of the Journal closes our Fourth Volume.

A statement showing our financial position will be published in Vol. V, Part I, which will appear in October.

*
* *

OUR membership has been sadly depleted owing to the War, and we shall require the united efforts of our subscribers to fill up the gaps in our ranks.

*
* *

FROM the encouraging letters received from members we feel that the Journal is supplying a

long-felt want in the Agricultural and Dairying circles in India.

An endeavour is being made to publish that material which is applicable to India, and so make a valuable ready reference book for dairy men and agriculturists. Home literature does not always supply our requirements; hence an Indian Journal, based on Indian conditions, will be of great value to us and to our confrères.

***

We see in the papers that Major Matson's report on the Calcutta milk supply will be published in a few months' time. Such a report will be of immense interest and will do much to further the cause of a pure milk supply to the cities of India. We hope to be able to publish the report verbatim.

***

We also await with interest some article from our energetic former Secretary, Captain G. H. Frost, on the outlook of dairying in Mesopotamia

***

Members of the Association are reminded that the Annual Examination for the National Dairy Diploma will be held in December next. The date will be intimated hereafter.

Arrangements will be made, where possible, for candidates to sit in their own stations, under the supervision of selected officers. The entrance fee of Rs. 20 should be forwarded with the application to the Honorary Secretary, 85, Survey Road, Quetta.

***

It was decided that the first issue of the Journal of Dairying for each year should be forwarded by V.-P. P.

The postal and commission charges by this method cause heavy expense on the funds of the Association.

It is decided this year, as an experiment, to forward a notice to each member, asking him to forward his subscription as early as possible after the 1st October, as convenient. To those members who do not forward their subscriptions the first issue of the Journal will be forwarded V.-P. P.

It is hoped, however, that all members will send their subscriptions, *viz.*, Rs. 5, to obviate the necessity of the V.-P. P. method.

*
* *

New members are reminded that back numbers of the Journal are obtainable from the Honorary Secretary.

*
* *

In this issue we have continued, for the help of students, the sample answers to the questions set at the last N. D. D. Examination.

The questions of Sections VIII and IX appeared in Vol. IV, Part III. In this number we have dealt with Sections II, III, IV, VI, and VII. We have been compelled to omit Plan for Model Creamery and Cross-Section of Second Class Road, owing to the expense of obtaining blocks. The Honorary Secretary is arranging for blue prints to be made, and they will be supplied to any student desirous of procuring one.

* *

The following gentlemen have been elected by the Committee as Members and Associate Members of the Association :—

Members.

The Superintendent, Agricultural Station, Surat.

Mr. B. S. Patel, N.D.D., N.D.A., Cheese Expert, Government Central Creamery, Ahmedabad.

Mr. W. M. Mackenzie, Cattle Breeding Farm, Sepaya.

Associate Members.

W. Birch, Esq., Assistant Commissioner in Scinde, Government House, Karachi.

Messrs. Daya Ram and Sons, Government Contractors, Shikarpur, Scinde.

Mr. Lofts, Government Dairy Farm, Ruk, Scinde.

Mr. R. Dolman, Government Dairy Farm, Ruk, Scinde.

Mr. L. O'Brien, Government Central Creamery, Ahmedabad Cantonment.

Mr. R. S. Patel, Government Contractor, Mhow.

The President, Revenue Board, Bagdad, Mesopotamia.

Messrs. W. Crowder & Co., Ltd., Engineers, Karachi.

Messrs. B. R. Herman & Co., Engineers, Karachi.

Messrs. Kapoor Bros., Government Agents and Contractors, Ahmedabad.

RINDERPEST.

BY

R. OSBORNE, N.D.D. (I.)

A SHORT article on rinderpest will no doubt be of interest and, it is hoped, of some utility to our ever-increasing number of students, and also to dairy farmers and owners of live-stock.

The writer does not pretend to any original information on the subject, and hastens to mention that his elementary knowledge was acquired as a result of a brief course of study at the Imperial Laboratory at Muktesar. He had the pleasure of residing for a few weeks in that delightful little hill station, and takes the opportunity of expressing his gratitude to the members of the staff for their invariable courtesy and their readiness to give any desired information.

It is proposed to discuss the disease with special reference to cattle in India.

DESCRIPTION OF DISEASE.

Rinderpest is an acute contagious disease of ruminants.

It is very fatal. Cattle, sheep, goats, and camels are susceptible, also wild ruminants. Occasionally swine are attacked.

CAUSE.

It is caused by an ultra-microscopical organism, which up to now has not been isolated by bacteriologists, in spite of much work of investigation. The organism, or virus, is extremely minute, and will pass through a porcelain filter. It is contained in the blood

of diseased animals, also in the excretions, but not in the blood serum.

Outside the animal body its vitality is not great except in shady places or dung-heaps, etc., where it may remain infective for a considerable time.

Occurrence.

Rinderpest has spread practically all over Europe, Asia, and Africa, and is endemic in many places, including the plains of India.

It has broken out in epidemic form occasionally in Great Britain, but has been stamped out by the expensive method of destroying all affected and suspected animals.

Susceptibility and Immunity.

Cattle in India are susceptible in widely varying degrees.

Full investigation has not yet been made, but it is known that the Himalayan cattle are much more highly susceptible than plains cattle of the Bareilly District.

The difference is no doubt due to the more or less complete isolation of the former from infection, while the constant presence of the disease on the plains. and the consequent exposure of the plains cattle, is believed to have imparted to them some degree of hereditary immunity.

Cattle imported from Great Britain, Australia, and America are very highly susceptible to the disease, and their susceptibility is considered to be equal to that of Himalayan cattle.

Dr. Lingard estimated that 99 per cent. of cases in the latter breed proved fatal, and it can be assumed that the mortality among imported cattle would not be less than this figure.

Cattle which have recovered from an attack of rinderpest are immune for a prolonged period and perhaps for life in some cases.

Artificial immunity will be discussed under the head of inoculation.

Horses and men are immune.

Outbreaks.

The first symptom of the disease is a sudden rise of temperature to 105 or 106 degrees Fahrenheit. The animal is off its feed, has a staring coat, rumination stops, and, in the case of milch animals, the secretion of milk ceases. Small vesicles, the size of pin-heads, appear on the lips, gums, and *under surface* of the tongue.

Later on these vesicles break and form into ulcers. These vesicles and ulcers are very characteristic. It frequently happens that a cluster of these vesicles break together and form a comparatively larger ulcer. The animal presents a very miserable appearance, and lies down with its head turned towards its side.

Evil-smelling diarrhœa is present, sometimes streaked with blood.

The animal rapidly becomes emaciated and death ensues usually about the seventh or eighth day after infection. In natural outbreaks it frequently happens that the disease gains considerable headway before it is diagnosed. In such cases the rapid spread of the disease combined with high mortality should be sufficient warning. When rinderpest is suspected the mouth should be carefully examined for vesicles or ulcers. These are sometimes very small and difficult to find, but are rarely absent.

If these are present, together with a high temperature, high mortality, and diarrhœa, the diagnosis is practically certain.

Frequently acrid tears trickle away from the eyes, leaving a mark where they touch the cheek; also a discharge of mucus. The temperature drops on the approach of death and the animal usually sinks into a state of coma, and then dies.

Post-Mortem.

The post-mortem symptoms externally are extreme emaciation, and a discharge of mucus from the eyes and mouth.

Internal ulcers may frequently be found in the small intestine and also in the abomasum.

The mucous membrane of the small intestine is greatly congested and also the Peyers Patches. The

lungs assume a peculiar appearance resembling the marking on a piece of marble.

A practically infallible diagnosis may be made by finding longitudinal stripes on the rectum.

Comparison with other Diseases.

Rinderpest may be confused with other diseases such as foot and mouth disease and hæmorrhagic septicæmia.

In diagnosing rinderpest the following points should be remembered :—

1. The large number of animals attacked.
2. Numerous deaths.
3. High temperatures.
4. Vesicles and ulcers in mouth (very characteristic of the disease).
5. Rapid emaciation.

In foot and mouth disease there are sores in the mouth, but of a different type. These appear on the upper surface of the tongue as well as elsewhere, whereas the vesicles of rinderpest are never visible on the top of the tongue, they are usually far larger, and generally take the appearance of a patch of skin having been removed. In foot and mouth disease there is fever at the onset, but this does not persist. The rapid emaciation is not observed. The feet are usually affected in this disease which is not the case in rinderpest. The spread of foot and mouth disease is very rapid, but the results are seldom fatal.

Hæmorrhagic septicæmia is distinguished from rinderpest by the absence of vesicles and ulcers. There is a characteristic swelling in the throat in this disease which is absent in rinderpest. In hæmorrhagic septicæmia a post-mortem reveals a highly injected state of the blood capillaries of the mesentery (the covering of the stomachs and intestines revealed when the outer skin is removed) which appear as a fine network, very brightly coloured. In hæmorrhagic septicæmia death follows the first symptoms far more rapidly than in rinderpest.

In diarrhœa and dysentery the vesicles and ulcers are absent. The spread of these diseases and the fatal termination are not usually so rapid.

TREATMENT BY INOCULATION.

The only effective mode of dealing with an outbreak is by inoculation. There are two methods of inoculation in vogue in India, namely, the "serum simultaneous" method, which is useful as a protective measure *when the cattle are healthy*, and the "serum alone" method for use in an outbreak.

Serum Simultaneous Method.

This consists of injecting a quantity of virulent blood taken from a diseased animal into the shoulder of a healthy animal, at the same time injecting a protective dose of anti-rinderpest serum into the opposite shoulder.

The result is that the animal contracts a mild form of the disease and recovers. This mild attack establishes immunity lasting over a considerable period, termed active immunity.

The drawbacks of this system are :—

1. The difficulty of transporting virulent blood over long distances.
2. The risk of spreading the disease over large areas by accident.
3. The paucity of trained men qualified to undertake the work.
4. The uselessness of the method in an actual outbreak.
5. The possibility of animals occasionally dying of the disease through receiving an incorrect dose of either serum or virulent blood.

Serum Alone Method.

The "serum alone" method is of great value in an outbreak.

This method consists of injecting a protective dose of serum into all the herd immediately the outbreak is detected, commencing with the healthy animals, following with the "in-contacts," and finishing with the diseased.

The animals do not go off feed or stop milking in the case of milch animals. They can be milked and grazed as healthy animals, and there is no need of segregation from the infected stock.

Healthy animals contract a mild form of the disease and then recover. The properties of the serum have some slight curative effect on those animals which already have the disease, but as a rule those which have contracted the disease before inoculation generally die. This inoculation produces passive immunity lasting from three days to six weeks. Should the disease be prevalent in the district after three weeks it is necessary to inoculate the herd again.

The doses of serum necessary to confer immunity are as follows :—

	Per 600 lbs. weight.
Imported and half-bred cattle, and hill cattle	100 c.c.
Country cows	5 c.c.
Buffaloes...	30 c.c.

These figures may be considered as approximate, but should only be varied in favour of giving larger doses when there is any doubt as to the susceptibility of cattle. The instructions issued with the serum must of course be implicitly carried out. It may here be noted that extensive experiments with plains cattle have only been carried out in the Bareilly District of the United Provinces.

Cattle in other parts of the plains of India are assumed to be equally resistant to the disease, and up to now this view has usually been confirmed during outbreaks, except in Scinde where the animals were found to be more susceptible than those of the Bareilly District, and the same may be true of other places.

Careful observation of results in outbreaks is desirable to determine the degree of resistance shown in each district.

Other Treatment.

With the exception of inoculation there is no reliable treatment for rinderpest. Cross suggests the injection intravenously of large quantities of serum, but does not give any details. The serum in large quantities would no doubt have some curative effect, but it seems doubtful whether the average farmer would do much good by attempting such measures.

Intravenous injections require a skilled and practised hand, and even then are a somewhat risky procedure.

It would appear more advisable to exert every energy towards checking the spread of the disease rather than to attempt the cure of individual cases.

The strength of animals attacked by the disease should be maintained by stimulants and nourishing food, administered if necessary with a drench. Rice gruel has been found very useful for this purpose.

CONCLUSION.

The exclusion of all outside animals from the herd, isolation of new purchases and arrivals, and fencing of grazing grounds are very necessary precautionary measures.

Pay attention to stock of serum and renew when necessary.

Always keep sufficient hypodermic syringes in perfect order ready for instant use.

A brief recapitulation of the measures to be taken on an outbreak may now be made :—

1. Divide the herd into three lots—(*a*) diseased, (*b*) suspected and in-contacts, (*c*) believed healthy.

2. Inoculate all animals with "serum alone," and then allow herd to mix together. Carry out inoculation with all possible speed, every hour is of importance in preventing the spread of the disease.

3. Destroy all carcases by burning if possible, or bury deeply, with lime.

4. Thoroughly disinfect all standings and surroundings.

Rinderpest has in the past taken a very heavy toll of the cattle in India, and it will no doubt continue to do so for many years to come. The conditions of rural life in India require vast improvement, education will have to spread, and much prejudice overcome before any progress is made towards stamping out this destructive disease, but much can be done to curtail the losses in large herds.

OIL ENGINES.

BY

MESSRS. RIDDICK AND WOODFORD, N.D.D. (I.)

(*Continued from page* 162.)

IN the April issue of this Journal we have briefly explained the method of working a 4-cycle and 2-cycle oil engine, and have stated that, until the 2-cycle engine is better known in India, it is considered that the former will remain, for small industrial concerns, the best engine for economical working.

The point now to be considered is the type and make of engine best suited to the commercial needs of India. It is undoubtedly preferable to purchase an engine so adapted that both refined and crude oils can be used. We have already pointed out the value of using crude oils wherever practicable. Many users of these oils complain that their use renders it necessary to frequently clean the vaporizer of the engine. This is undoubtedly the case, and it has been found economical to use a mixture of cheap paraffin and crude oil in equal proportions.

Having decided to purchase a 4-cycle engine to use both refined and crude oils, it is necessary now to select the type best suited to our needs in India.

It is false economy to purchase an engine of unknown type. There are many first class makers producing an engine on which their reputation rests, and it is undoubtedly preferable to purchase one of these than one of a less known make. When selecting it is imperative that the engine should be simple working, containing no elaborate mechanism to puzzle the Indian mistri. All parts should be easy to get at.

The following points should be carefully considered :—

(1) The method of oil supply to the engine.
(2) The method of vaporization.
(3) The ignition.
(4) The method of governing the speed.
(5) It should be economical and silent working.
(6) Reliability and simplicity of construction.
(7) Reasonable price and cost for renewals.

Having thoroughly considered the above it is now necessary to find out what power is required It is a great mistake to purchase an engine with just sufficient power to run the machines. It is always advisable to carefully work out the horse power required to run the various machines and allow a good margin for waste power. A small power engine is not economical nor is it advisable to have too great a reserve power. By having a reserve power above actual initial requirements, it is possible to add from time to time additional machines to be driven by the same power. The engine need not always run at full speed. To run an engine at its maximum load is unwise ; therefore an engine which gives a low oil consumption under half load and when running lightly is recommended.

Do not be misled by the term "Brake Horse Power" ; it requires further qualification as "Test Brake Horse Power", or "Maximum Working Brake Horse Power." There is usually about 10 to 15 per cent. difference between the two terms.

It must always be taken into account that manufacturers quote the maximum of the engine working under perfect conditions, with oil of a known quality and manufacture. The buyer cannot expect under ordinary conditions to get the same results.

Then again, altitude is another point to be considered. An engine required to work at high level will give less power to the extent of 3 per cent. for every thousand feet of altitude.

Selection of Site for Engine.—The site for the foundation and erection of the engine should be carefully selected. It should be erected in such a position that there is room to get at every part without trouble.

There must always be noise when the engine is working, and with the explosions from the exhaust chamber, vibration is unavoidable. It is therefore necessary that the site selected should be as far away as possible from offices and dwelling houses.

If the engine is to work shafting from which other machines are to be worked, it should not be placed directly under the shaft as a perpendicular drive causes a strain on the engine and shafting and damage is likely to occur. Neither is too long a drive advisable as power is wasted.

Foundation.—It is remarkable in India how much this important point is neglected—a point which means everything in the smooth and efficient running of the engine.

Many owners of engines merely bolt the engine down, irrespective of whether it is correctly levelled up or whether the base is solid enough to bear the strain, and then expect good results. Such a procedure simply means the quick scrapping of the machine. The foundation should be excavated until a solid bottom for a strong bed is reached. Into the excavation concrete rubble, with lime and cement mixed in the right proportions, should be rammed down. Above the floor level the superstructure should be worked out according to the drawing supplied with each engine. The bolts should be left loose until the foundation is complete, and the engine placed upon its bed and lined up to the shafting which it has to drive. A good plan is to make square boxes, wider at the top than at the bottom. These are built into the foundations at the places at which the bolts are likely to be put. After the engine is lined up, the boxes should be knocked out and rich cement run into the spaces around the bolts. The boxes are made larger at the top in order to ensure easy removal.

After lining up and bolting down, the engine should not be started until the foundation is properly set.

(*To be continued.*)

DAIRY FARM MANAGEMENT IN INDIA.

BY

MEOLICAN.

(*Continued from page* 155.)

BACTERIOLOGY APPLIED TO AGRICULTURE.

THIS is a most important factor in the science of agriculture, particularly so to the Dairy Farmer. It is upon a knowledge of the action and habits of bacteria that the principal axioms of Dairy Hygiene are based. The important part that micro-organisms play in the production, curing and preservation of dairy products, and also in the destruction of the keeping qualities of these products, necessitates some study of the habits and capabilities of this invisible multitude.

It is not necessary for the farmer to study this science to the same extent as the specialist, but it is essential that he should know the manner in which various classes of these organisms are of use to him. In the case of the agriculturist he should study the action of certain bacteria upon the soil, for it is upon their activities that the productiveness of the soil to a large extent depends. Such a knowledge enables both the dairy farmer and the agriculturist to bring under control the services of those organisms which are beneficial, and to destroy those that are detrimental to their respective requirements. Considerable information has been prepared and published in various books; and many of our schools and colleges are now equipped to demonstrate the application of elementary bacteriology to practical agriculture.

Plants of the legume family possess the power of attracting certain bacteria which can utilise free nitrogen

for their growth and also store up a reserve in the soil for future crops. The cultivation and preservation of desirable organisms is therefore an important point for the farmer's consideration. Their utility can be applied in such a manner that the full benefit of their activities can be turned to the farmer's advantage, who with their aid, is able to develop to the utmost the resources of his soil.

Much of the plant food contained in the soil is locked up in organic compounds, and is of no use to plant life until liberated in an assimilable form. This means that many compounds must be broken down—a process which invariably involves a chemical change brought about by some reducing or oxidising agent. In the open air this work is often done by the action of oxygen, but in the absence of oxygen it is carried out by living micro-organisms, known as nitro-bacteria, of which there are two classes—nitrous bacteria and nitric bacteria.

The nitrous bacteria begin the work of nitrification by changing ammonia compounds, which abound in manures, into nitrites. When this process is completed, the nitric bacteria take up the work by changing the nitrites into nitrates, thereby converting the original compound into a form assimilable by plants. This is called the process of nitrification, but another set of bacteria cause what is known as denitrification, causing the loss of nitrogen to the soil, and the farmer should study the correct method of frustrating the work of these latter organisms, and the means by which nitrogen may be fixed in the soil.

In the ripening of cream for butter making, a clean lactic acid flavour is to be aimed at, and this result can be obtained by the scientific control of the Lactic Acid Bacillary Group. A knowledge of the work of these bacteria enables the dairy farmer first to destroy practically the whole of the bacteria in the raw product and then to inoculate it with a pure ferment or starter. By this means he is able to obtain butter of a good flavour and of good keeping qualities.

Cheese making also owes its success or failure to the presence of suitable organisms—various bacteria, moulds and yeasts. The casein or coagulable protein of

milk is usually first precipitated by the action of rennet. The ripening of this casein is then carried out by the scientific inoculation with the special group of organisms characteristic of the type of cheese to be made. "Diseases" of cheese, like those of butter, are caused by the presence of harmful bacteria, different varieties affecting the product in different ways.

In the curing of hay and silage we are assisted very considerably by a number of these microscopic organisms, and we make good or bad hay or silage just to the extent that we can regulate their activities.

The destruction of solid constituents in creamery sewage.—In the septic tank system various organisms destroy the solid matter and reduce it to a liquid state, thus rendering its disposal much easier. The liquid can be run into rivers or tanks without ill effects from objectionable residue.

The foregoing paragraphs have dealt chiefly with the forms of bacteria which can be made useful and brought into the service of man. We have also to study those that are harmful in order to destroy them or restrict their activities, otherwise they are capable of killing our live stock, ruining our soil and products, to say nothing of their danger to man.

This group of hostile organisms have to some extent been dealt with in a recent article on "Hygiene, or Disinfection on the Farm" published in a previous issue of the Journal.

It should be quite apparent, even from this short article, that bacteriology is not a side-issue of farming, but one that is of considerable importance.

In the syllabus for the N. D. D. examination we are given an idea of the points to be studied and the books best suited for the purpose. In Indian farming a knowledge of bacteriology is of the greatest value, and it is hoped that in the near future we may be able to publish in this Journal simple articles in this connection to enable the student to follow up the study of this important subject.

QUESTIONS SET AT THE LAST N. D. D. EXAMINATIONS, WITH ANSWERS.

SECTION II.—GENERAL DAIRYING.

Total Marks: 100. *Time Allowed:* 4 *hours.*

Question 1.—Give the five most promising breeds of milch cattle and two breeds of buffaloes in India, showing their habitat and the localities for which they are best suited.

Answer

The five best breeds of milch cows in India are :—

	Breed.		Habitat.
1.	Scindi	...	Scinde, more especially in the Karachi District.
2.	Sanhiwal	...	Montgomery District of Punjab.
3.	Hansi or Hansi-Hissar.		Hissar District of Punjab.
4.	Gir	...	The Gir hills of Kathiawar.
5.	Ongole	...	Southern India and Madras Presidency.

1 Scindi cattle, in common with most breeds, do best in their own locality, but they have been exported as far afield as Poona and do well. Many are sent to Bombay annually.

2. Sanhiwal cattle have spread all over Northern India in the Military Farms Department, and do well in most places.

3. The Hansi does not bear removal from its own district so well as those abovementioned, and although it does well in Cawnpore and Allahabad, it deteriorates rapidly in Jubbulpore and Calcutta.

This breed appears unsuitable for humid climates.

4. Gir cattle are found in Bombay in considerable numbers, and appear to do well in moist climates. They have not been tried on a large scale in the Farms Department.

5. Ongole cattle have not to my knowledge been exported to any extent, and they are known only in Southern India.

Buffaloes.—The premier breed of buffaloes in India is the Delhi or Murrah breed. This animal has been transported successfully all over India, though it undoubtedly excels in the southern part of the Punjab.

Another breed of buffaloes which is well known is the Surti breed from Gujerat. This breed does well in Bombay, but has not done so well in Poona. It appears that a hot plains district suits this breed best. Indeed, experience seems to indicate that buffaloes thrive best in hot dry places. For example, these animals do excellently in the hot rainless districts of Scinde, but very indifferently in the humid districts of Bengal.

Question 2.—You are asked to establish a Dairy Farm to supply 2,000 lbs. of milk and 300 lbs. of butter per day, the former from your own stock and the latter from the Creamery, say, at Ahmedabad Cantonment. Give the number and breed of cows and buffaloes you would require, with figures showing the number and breed of bulls you would use. Also give the strength of your herd after running for three years and what land you would acquire.

Answer.

The question of establishing a dairy at Ahmedabad requires some consideration. There are three sources from which cattle might conveniently be obtained.

1. Scindi cattle might be purchased. The advantage of this is that the breed is well known, but there is no information to show how this breed would suit Ahmedabad.

2. The Gir cattle might be tried. These have the advantage of being practically a local breed, but little is known of their adaptability for large dairies.

3. Gujerat buffaloes might be purchased. These are local also, and would no doubt do well.

As there is no milk required for butter-making, it would be advantageous to establish a herd of cows, cross them with Ayrshire bulls, and create a half-bred herd. It is known that the Ayrshire and Scindi cross well; so I am of opinion that it would be a good policy to have two-thirds of the herd Scindi and the remainder Gir.

The latter would be introduced more or less as an experiment, to be extended later if proving satisfactory.

All animals when purchased should be giving not less than 10 lbs. per diem, so a herd to give 2,000 lbs. of milk on this basis should be 200 strong. However, to cover fluctuations and allow for animals drying off, a margin of 20 per cent. should be allowed, thus purchasing 240 head of milch cows, *i.e.*, 160 Scindi and 80 Gir.

Six Ayrshire bulls would be necessary on a basis of two for the first fifty cows, and one for each 50 afterwards.

The calves, if any, purchased with the cows would be disposed of as soon as convenient. Casualties among the milch stock would be replaced as they occur. All male calves would be disposed of, so that at the end of the first year, assuming that all the cows calved normally the herd would be :—

Bulls.	Cows	Calves.
6	240	80

and at the end of the third year :—

Bulls.	Cows.	Calves.
10	240	240

The number of bulls would be increased to allow for the service of the young stock heifers.

Land would be taken up on the basis of one-third of an acre for home farm for each head of milking stock for intensive farming, two acres per head of dry and young stock for extensive farming.

In all some 700 acres of land would be required.

Question 3.—Having selected your land for above and decided on the site for your buildings, make a site plan showing the position of each of the buildings you consider necessary and their respective distances from main and subsidiary roads and each other.

Answer.

Separate prints of a site plan will be ready shortly for issue to students.

Question 4.—Give the advantages that may accrue to dairy farmers and municipalities by using railways and motors for transport of milk and butter and how it should be treated for long distances.

Answer.

See Vol. IV, Part I, page 21, *Journal of Dairying.* "Transport of Milk by Modern Methods," by "Maori."

Question 5.—State your ideas as to the present condition of breeding in India and how you would effect an improvement without losing the advantages of immunity.

Answer.

See separate article in this Journal on notes taken of a lecture to students by W. Smith, Esq., and published by R. C. Woodford, N.D.D.(I.), Vol. IV, Part III, page 163.

Question 6.—State how a calf should be reared and when its rearing commences.

Answer

The rearing of a calf, though actually commencing at birth, may be prepared for by care and thought beforehand.

Immediately it is known that a cow has conceived, preparations should be made to bring the calf into the world in the best possible condition. Allowances should be made in the rations of the cow to enable it to bear the strain of producing large quantities of milk and also of nourishing the unborn fœtus. The maternal instinct is so strong that under-feeding would first cause a reduction in the milk flow, and care should be taken that the cow receives sufficient food for maintenance, milk-production, and support of the growing fœtus.

Secondly, it is bad for both cow and calf if the cow is allowed to give milk right up to the time a calf is born. She should, if possible, be dried off three weeks or a month before she is due to calve.

The calf should be weaned at birth, but should receive its mother's milk for a time after birth, when it may be gradually substituted with separated milk and meal. Calves should never be allowed to get thin; their food should be regulated so that they continue to grow.

The following ration is considered suitable :—

First week ...	6 lbs. new milk.
Next 3 weeks ..	2 lbs. new milk. 4 lbs. separated milk. 6 ozs. meal (cotton-seed, linseed, or oatmeal).
1 to 3 months ...	8 lbs. separated milk. $1\frac{1}{2}$ lbs. meal.
3 to 9 months ...	10 lbs. separated milk. 3 to 4 lbs. meal.

When the calf begins to pick up fodder, give as much sweet and tender hay as it will eat.

Provide rock salt for licking

It is important that calves should be housed separately according to ages.

A good system is :—

Under 1 month...	1 pen or batch.
1 to 3 months ...	,,
3 ,, 6 ,, ...	,,
6 ,, 9 ,, ..	,,
Above 9 ,, ...	Transfer to young stock.

Racks in calf pens on the floor to protect the animals from cold and damp are important, and bedding should be provided for young animals.

Question 7 —Give the benefits and difficulties met with in weaning Indian calves on the British system, *viz.*, weaning at birth.

Answer.

See article on Rearing of Calves on Government Military Farms, pages 79 to 82, Vol. IV, Part II; and Vol. IV, Part I, page 12, Weaning of Calves in India, by H. W. Veall.

Section III.—Agriculture and Dairy Engineering.

Possible Marks: 100. *Time Allowed:* 5 *hours.*

Question 1.—Give briefly the uses that can be made of the following on a dairy farm :—

(*a*) Dumpy-level.
(*b*) Plane table and sight vane.
(*c*) Prismatic compass.
(*d*) Gunter's chain.

Answer.

The Dumpy-level and staff can be used on a farm for —

1. Levelling plots for irrigation.
2. Obtaining levels for road construction.
3. Obtaining levels for laying out canals or irrigation channels.

The plane table and sight vane can be used for measuring, plotting, and surveying land either for agricultural or building purposes.

The prismatic compass is of use in surveying and plotting, laying out roads, etc , determining boundaries where maps exist and boundaries are ill-defined. It can be used either separately or in conjunction with the plane table.

The Gunter's chain is useful for measuring, and is practically indispensable when surveying operations are going on. Its length and divisions make it particularly suitable for agricultural purposes, it being divided into 100 link, and as 100,000 square links equal an acre it is specially convenient. It is best for use with the plane table, when boundaries may be accurately defined and land rapidly measured and mapped.

Question 2.—Give a cross-section of second class road showing material used, and state general cost of construction per yard.

Answer.

Prints of a cross-section of second class road will be published later.

A road should be constructed of large metal for the foundation. Large stones are very suitable, but if

not available, burnt bricks may be used. The bed of the road should be convex, and this convexity should be continued until the road is finished. On the top of the stone foundation a layer of smaller stones may be placed, and well rolled in, and again above that gravel should be spread and rolled. The road may be surfaced with sand.

Kankar, a form of limestone, is extensively used in some parts of India for road making, and is very suitable. Berms should be maintained on both sides of the road to prevent the metal from spreading and drains constructed large enough to carry away rain water.

Keeping a road watertight and well drained reduces the cost of upkeep, and holes should never be allowed to remain where water can accumulate.

The cost of a road as above should be roughly Rs. 5 per running yard, but this varies greatly according to whether metal is plentiful or not.

Question 3.—Give with approximate cost the chief items, dead stock, miscellaneous stock, and miscellaneous stores required for the dairy mentioned in Question 2 of Section II.

Answer.

The chief items of plant, furnishing, etc., required for a dairy to produce 2,000 lbs. milk from its own herd, and handle 200 lbs. butter, from Ahmedabad Creamery are :—

DEAD STOCK.

		Rs.
1.	Steam Boiler, Vertical, 7′ × 3′ 6″ ..	2,500
2.	Engine, Steam, 8″ × 10″	1,000
3.	Pasteuriser	350
4.	Separator, Alfa Laval P. V.	750
5.	Dynamo, 2½ K. W.	2,000
6.	Refrigerator, Hall's Ammonia... ...	2,700
7.	Churn Champion No. 6	100
8.	Butter Worker, Cunningham	50
9.	Bamford's Mill	750
10.	Cake Crusher	75
11.	Chaff Cutters, Climax G. 3, two ...	2,000
12.	Oil Engine, Fielding, 20 B.H.P. ...	2,800
13.	Conical Cream Cooler	150
14.	Icy Cold Refrigerating Cooler ...	190

					Rs.
15.	Sabul Ploughs	20	total	...	500
16.	Disc Ploughs	10	,,	...	500
17.	Seed Drills	3	,,	...	330
18.	Harrows, Disc	3	,,	...	360
19.	Harrows, Pegtine	4	,,	...	200
20.	Carts, Country Bullock	10	,,	...	300
21.	Carts, Delivery Mule	4	,,	...	600
22.	Butyrometer, Gerber's, Astoria B.			...	150
23.	Cans, Milk, Railway	17 gallons,	10 total		300
24.	,, ,, ,,	12 ,,	10 ,,		250
25.	,, ,, ,,	8 ,,	10 ,,		150
26.	Milk Receivers		2 ,,		70
27.	Fencing Wire, (as required) ...			...	
28.	Trap for Manager	...		...	200

MISCELLANEOUS STOCK.

				Rs.
Milking Pails ...	...	...	24	36
Herd Recorders	...	...	3	120
Milk Pails ...	...	...	12	24
Cans, 2 gallons	...	...	20	100
,, 1 gallon	...	...	20	60
Bottles, 2 lbs.	...	...	2 gross	144
,, 1 lb.	...	...	2 ,,	126
Bottle Cappers	...	...	2	20
Pincers for Seals	...	...	...	7
Deliverymen's Suits	...	...	8	24
Gowallas' Suits	...	...	60	120

MISCELLANEOUS STORES.

				Rs.
Butter Salt ...	...	...	2 cwt.	7
Cream Mugs, 2 oz.	...	...	5,000	70
,, ,, 4 ,,	...	...	2,000	45
Butter Paper ...	...	...	5 cwt.	20
Tin Seals ...	..	...	10,000	23
Butter Muslin	...	...	1 cwt.	50

Question 4.—Draw a ground plan of a creamery which is to turn out 2,000 lbs. of butter per day from purchased milk, showing the position of each machine.

Answer.

A ground plan of a suitable creamery to turn out 2,000 lbs. butter daily will be published later.

Question 5.—What is the function of the safety valve on a steam boiler, also the uses of the fly-wheel and governor on a steam engine.

Answer.

The safety valve on a steam boiler, as its name implies, is provided as a safeguard for the boiler and its attendants. There are various types of safety valve, the commonest being the lever, the dead weight, and the spring types. Most boilers are fitted with two valves, often of different types. The valve is arranged so that when the pressure of steam rises above the safe limit, the steam escapes with a rush, thus relieving the pressure within the boiler and averting an explosion. The safety valve is of special importance in view of the possibility of the pressure gauge going out of order, when there would be no visible sign that the pressure is approaching the danger point.

The fly-wheels and governor on the engine regulate the speed and steadiness of the running.

The governor is usually operated by the centrifugal force generated by the revolutions of the engine. When the engine, owing to a sudden lightening of the load or perhaps an increased steam pressure, begins to "race," the governor comes into play by heavy balls being thrown outward by centrifugal force which either cuts off or throttles the steam, thus again reducing the speed to normal.

The fly-wheels store up energy by reason of their weight and assist in maintaining the steadiness of the running.

Question 6.—Given an engine running at 175 R.P.M. with a belt pulley of 36″ diameter, what speed would you run your shafting and what pulleys would you require to drive—

(*a*) Cream separator.
(*b*) Power churn.
(*c*) Milk pump.

The speeds and size of pulleys being :—

	Dia. of pulley.	R. P. M.
(*a*)	6″	550
(*b*)	18″	175
(*c*)	20″	60

Answer.

With engine running at 175 R P.M. and the shafting at 150 R.P.M. a 42″ driven pulley on the shafting would be necessary.

The driving pulleys for the various machines would then be as follows :—

Separator	... ...	22″
Churn	... ...	21″
Milk pump	... ...	8″

Note.—When a driving pulley required works out at an odd size, the next larger pulley should be fitted, as it is more probable that speed may be lost than gained in power transmission.

Question 7.—What part does compression play in the internal combustion engine and what are the chief probable causes of its loss ?

Answer.

Compression is necessary in the cylinder of an internal combustion engine, because gases exploding exert far more force when confined in a small compass. In addition, the temperature of the gas mixture rises under compression rendering it more highly inflammable.

The chief probable causes of its loss would be dirty and leaky valves incorrectly set, worn piston, or worn out or ill-fitting piston rings.

Question 8.—What do you understand by a four-cycle engine and what is the difference between an internal combustion engine and a steam engine ?

Answer.

A four-cycle engine is an internal combustion engine depending upon oil or petrol for its motive power. It is worked on a cycle of operations which are continuous. Each stroke of the piston corresponds to one of the operations in the cycle, and there are four strokes to each explosion. The first stroke in the cycle is on the piston, and it being drawn outwards, valves open and admit vapour from the vaporiser, and air from the air valve, into the chamber.

The inward stroke of the piston compresses the mixture. It is then fired, and the piston is forced

outwards by the force of the explosion. *This is the working stroke.*

The return stroke commencing, the exhaust valve alone opens and the exhausted gases escape.

This completes the cycle, and the operations again commence in the same order. The four operations above described are :—

1. Admission of the gas mixture.
2. Compression of the gas mixture.
3. Combustion of the gas mixture.
4. Expulsion of the exhausted gases through the exhaust valve.

The difference between the internal combustion engine described above and a steam engine is that, while the energy which drives an oil engine is derived or produced inside the engine itself, in the case of a steam engine, a boiler is necessary to convert the latent energy in the coal into active energy in the steam.

Steam is generated in a boiler and the engine is merely the mechanical means by which the steam energy is converted into reciprocating motion.

The steam engine is provided with a piston and cylinder somewhat similar to that of an oil engine, but instead of using the explosion of gases to drive it, steam is admitted alternately at the front and back of the piston, and thus drives the piston backward and forward.

Question 9.—What are indications of—

(*a*) Too rich a mixture in oil or petrol engines.
(*b*) Too weak a mixture in oil or petrol engines.

Answer.

This will be dealt with in full in the series of articles now appearing under the title of "Oil Engines," by Messrs. Riddick and Woodford, N.D.D.(I.).

Question 10.—What type of pump would you instal in the following conditions :—

(*a*) If you had an abundance of water with a fall of 100 ft. and where you wished to raise it 500 ft., assuming that you wanted 40,000 gallons per day.

(*b*) If you wish to lift water from a well 100 ft. deep and to raise it to a tank 15 ft. above ground, assuming that you wanted 16,000 gallons per day.

(c) If you wish to lift water (200,000 gallons per day) from a river which is 70 ft. below your supply or distribution tank.

Answer.

I would instal pumps as follows :—

(a) For water with a fall of 100 ft. I would use a Hydram pump, utilising the hydraulic force of the falling water to elevate to the required point.

(b) For a well pump the most satisfactory is a Kite motion pump, though there are various types of deep-well pumps.

For the present purpose I would prefer a three-throw pump driven by an electric motor if such power were available, otherwise by oil engine.

(c) For large quantities of water to be lifted from a river for irrigation the most satisfactory pump is the centrifugal pump driven by an oil engine.

Section IV.—Agriculture Chemistry.

Possible Marks: 100. *Time Allowed:* 4 *hours.*

Question 1.—What are the chief elements needed for plant life and from whence are they obtained and how ?

Answer.

The chief elements needed for plant life are oxygen, hydrogen, nitrogen, carbon, lime, iron, phosphorus, sulphur, magnesium, chlorine, alumin, potash, and silica.

Oxygen and hydrogen are obtained in the form of water, which is taken up by the roots. Nitrogen is obtained from the soil, and in the case of leguminous plants from the air also. The nitrogen taken from the soil is obtained from decaying organic matter which is acted upon by bacteria, which, feeding on nitrogenous substances, produce in turn ammonia, nitrous acid, and finally nitric acid. In the latter state the nitrogen is available for plant food, as nitric acid is soluble in water. The nitrogen taken by legumes from the air is fixed by bacteria which attach themselves to the roots of plants, forming nodules on the roots. A large proportion of

this nitrogen remains in the soil when a leguminous crop is cut for fodder. Carbon is taken from the air by means of minute mouths called "stomata." It is obtained in the form of carbon dioxide. The remaining constituents are taken from the soil in solution, the dissolving of these minerals being greatly assisted by the action of humus acid formed by the decay of organic matter. A large proportion of the water taken up by the plants is evaporated from the leaves. The remainder remains as an essential part of the growing plant.

The process by which moisture and nutrients are taken up and distributed to different parts of plants is known as osmosis.

Question 2.—Give the chief chemical constituents in good soil and show which are most easily lost. Show by what means you would prevent their exhaustion ?

Answer.

The chief chemical constituents of good soil are—

Organic.—Nitrogen.

Inorganic.—Iron, lime, phosphorus, sulphur, magnesia, chlorine, alumin, potash, and silica.

The three most easily lost are nitrogen, phosphorus, and potash.

Phosphorus and potash must, when deficient, be replaced by manuring, as also may nitrogen. Potash is readily available in wood ashes.

It is possible, however, to replenish the nitrogen by the growth of legumes, when the nitrogen is fixed by bacteria. In dairy farming, when a liberal supply of farmyard manure is available, the phosphorus and potash will rarely be deficient to any extent, but, if farmyard manure is not available, artificial manures may sometimes be purchased, though they are not always readily available in India. Phosphates may be obtained in the form of guanos, fish manures, and offal ; also from bone manures.

Soil exhaustion can be prevented to a considerable extent by careful rotation of crops.

Question 3.—Give some ideal methods of dealing with the manure on a dairy farm where you have 300 acres of land around steading ?

Answer.

The manure may be distributed on to the land direct for a considerable portion of the year. During the dry weather it is an advantage to cart manure direct to the fields, spread it, and if possible plough it under immediately. This ensures the land getting the utmost benefit out of the manure. If the manure lies on the surface exposed to the sun and air, heavy losses are incurred through the evaporation of gases principally ammoniacal, resulting in a loss of nitrogen, which is very valuable. This method of disposing of manure is applicable whenever animals and carts can get on to the land. During the wet weather there is no alternative but to store the manure in pits which should, to effect the greatest saving, be protected from sun, rain, and drainage water.

It is advantageous to have the pit made impervious, and concrete sides and bottom, though expensive, are very effective. A cheaper substitute is to have the bottom of the pit well rammed and hardened, but this depends much upon the class of soil in which the pit is prepared. Pits should all be emptied during the ensuing hot weather. The liquid manure is also most valuable and is difficult to preserve. It may be run on to the land throughout the year by means of well-constructed drains, care being taken that it is well diluted and also that it is well distributed.

There is a tendency for one or two plots to receive all the liquid manure, unless a careful watch is kept, resulting in a heavy waste of valuable manure and a deterioration of the crops grown on those plots owing to the land being too richly manured.

Question 4.—It is assumed that the following feeding stuffs are bought yearly :—

100,000	lbs.	Cotton seed meal	Chemical constituents given on following page.
100,000	,,	Wheat bran	
100,000	,,	Gram	
500,000	,,	Kirbee, or Churi	

This same dairy sells 400,000 lbs. milk yearly, 50 adult cattle, and 150 calves yearly, and a stack was burnt containing 250,000 lbs. of kirbee.

Chemical Constituents in 1,000 lbs.

NAME OF FEED.	Total Ash	Potash K_2O	Soda Na_2O	Lime CaO	Magnesia MgO	Iron Oxide Fe_2O_3	Sulphuric Acid H_2SO_4	Phosphoric Acid P_2O_5	Silica SiO_2	Chlorine Cl	Nitrogen N
Cotton seed meal ...	66·00	15·80	...	2·90	10·00	0·84	12·20	30·40	5·48	0·03	72 5
Wheat bran ...	58·00	15·20	0·40	1·70	9·70	0·34	5·00	26 90	0·26	...	24·6
Gram	15·00	5·70	0·20	0·30	2·30	0·11	3·90	7·10	0·31	0·14	37·9
Kirbee, or Churi ...	34·00	10·90	6·50	4·30	2·10	0·71	3·20	3·80	9·10	0·41	5·5
Calf	...	2·06	...	16·46	0·79	...	...	15·35	...	...	24 64
Ox	...	2·05	...	21·11	0·85	...	..	18·39	...	...	27·45
Milk ash per cent.* ...	...	28·71	6·67	20·27	2·80	...	..	29·33	...	12·22	...

* Ash in 1,000 lbs. milk, 7 lbs.

Nitrogen in 1,000 lbs, milk, 5·76 lbs.

The whole of the manure, both solid and liquid, is used on the 200 acres of dairy land, which is farmed intensively.

State whether the soil loses or gains from continuous cropping, showing approximately which constituents increase and which decrease, if any.

Answer.

See statement on next page.

Question 5.—Give the food units and cost per unit, also albuminoid ratio of the following feeding stuffs (digestible) per cent :—

	C-H.	Protein.	Fats.	Cost per 100 lbs.		
Bran ...	42·0	11·9	2·5	3	0	0
Barley ...	65·0	8·4	1·6	3	4	0
Oats ...	49·2	8·8	4·3	4	8	0
Rice dust ...	38·8	7·6	7·3	1	8	0
Linseed meal ..	35·7	31·5	2·4	4	0	0
Cotton seed meal ...	21·4	37·6	9·6	3	12	0
Cotton seed hulls ...	33·2	0·3	1·7	0	12	0
Milk (pure) ...	4·5	4·3	7·5	6	4	0
Lucerne (green) ...	12·1	3·6	0·4	0	8	0
Hay ...	42·0	4·2	1·3	1	10	0
Kirbee (green) ...	11·6	0·6	0·3	0	6	0

Answer.

The number of food units available in feeding stuffs may be calculated by considering the proteins and fats as being 2½ times as valuable as the carbo-hydrates for feeding purposes. Thus the number of units equals :—(proteins and fats by 2½) plus carbo-hydrates.

The cost per unit is arrived at by dividing the cost per 100 lbs. by the number of units.

The albuminoid ratio is arrived at by multiplying fats by 2½, adding carbo-hydrates, and dividing the whole by the proteins.

(ANSWER TO QUESTION 4.)

Sources of Gain to Soil.

FEED.	Ash	Potash K_2O	Soda Na_2O	Lime CaO	Magnesia MgO	Iron Oxide F_2O_3	Sulphuric Acid H_2SO_4	Phosphoric Acid P_2O_5	Silica SiO_2	Chlorine Cl	Nitrogen N
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Cotton seed meal—100,000 lbs. fed	6,600	1,580	...	290	1,000	84	1,220	3,040	548	3	7,250
Bran—100,000 lbs. fed ..	5,800	1,520	40	170	970	34	500	2,690	26	...	2,460
Gram—100,000 lbs. fed ...	1,500	570	20	30	230	11	390	710	31	14	3,790
Kirbee—250,000 lbs. fed; 250,000 lbs. burnt ...	17,000	5,450	3,250	2,150	1,050	355	1,600	1,900	4,550	205	1,375*
Total gain ..	30,900	9,120	3,310	2,640	3,250	484	3,710	8,340	5,155	222	14,875

Sources of Loss to Soil.

FEED.	Ash	Potash K_2O	Soda Na_2O	Lime CaO	Magnesia MgO	Iron Oxide F_2O_3	Sulphuric Acid H_2SO_4	Phosphoric Acid P_2O_5	Silica SiO_2	Chlorine Cl	Nitrogen N
150 calves sold weighing 100 lbs.	...	31	...	247	12	...	...	230	...	...	370
50 adults sold at 1,000 lbs. each	...	103	...	1,055	43	...	...	920	...	...	1,373
Milk 400,000 lbs.	...	804	187	568	78	...	...	821	...	342	2,304
Total loss ..	...	938	187	1,870	133	...	...	1,971	...	342	4,047
Difference gain ...	...	8,182	3,123	770	3,117	484	3,710	6,369	5,155	..	10,828
Difference loss ...	...	...	...	...	...	...	..	...	...	120	...

* NOTE.—Nitrogen contents of the burnt stack was lost.

By the above methods the articles given in the question work out as follows :—

Feed.		No. of Food Units.	Cost per Unit. a.	p.	Albuminoid Ratio.
Bran	... ...	78		7·39	1 : 4
Barley	... ...	90		6·93	1 : 8
Oats	... ...	82		10·5	1 : 7
Rice dust	... ...	76		3·79	1 : 7·5
Linseed meal	... ...	120		6·4	1 : 1
Cotton seed meal	...	139		5·18	1 : 1
Cotton seed hulls	...	38		3·79	1 : 124
Milk (pure)	... ...	34	2	11·3	1 : 5
Lucerne (green)	...	22		4·36	1 : 3
Hay	... ...	56		5·6	1 : 10
Kirbee (green)...	...	14		5·2	1 : 20

Question 6.—Give the digestible nutrients required by the following :—

(*a*) Milch cow weighing 1,000 lbs. and giving 22 lbs. of milk daily.

(*b*) Bullock at heavy work weighing 1,000 lbs.

(*c*) Growing heifer weighing 500 lbs., age about 10 months.

Make up a suitable ration for (*a*) from data given in Question No. 5.

Answer.

The digestible nutrients required are as follows :—

	Protein. lbs.	Carbo-hydrates. lbs.	Fat. lbs.
(*a*) A milch cow of 1,000 lbs. weight giving 22 lbs. milk daily ...	$2\frac{1}{2}$	13	$\frac{1}{2}$
(*b*) Bullock weighing 1,000 lbs and at heavy work ...	$1\frac{1}{2}$	16	$\frac{1}{2}$
(*c*) Growing heifer weighing 500 lbs. about 10 months old	1	4	·05

Ration for a milch cow weighing 1,000 lbs. and giving 22 lbs. milk daily. The figures given above are those given by American writers. It is probable that in India a slightly wider ration might be fed.

RATION.

Food stuff.	Carbo-hydrates.	Protein.	Fats.	Cost. Rs.	A.	.
Cotton seed meal 2 lbs. ...	·428	·752	·192	1	2	4
Bran 2 lbs. ...	·840	·238	·050	0	11	5
Hulls 5 lbs. ...	1·660	·015	·085	0	7	2
Green lucerne 20 lbs. ...	2·420	·720	·080	1	7	2
Hay 20 lbs. ...	8·400	·840	·230	5	2	4
	13·748	2·565	·637	8	14	5

Albuminoid ratio 1 : 6

SECTION VI.—VETERINARY SCIENCE.

Possible Marks: 100. *Time Allowed:* 4 *hours.*

Question 1.—Describe the digestive system of the cow, showing what relation it has to milk production.

Answer.

The digestive system of a cow, in common with all higher animals, is very intricate, and is a remarkable instance of the superiority of nature's contrivances over the finest machine ever constructed by man.

Briefly, it may be divided into two sections, mechanical and chemical, although the two processes proceed simultaneously.

The mechanical duties are performed by the teeth, stomachs, and digestive tracts, and the chemical action takes place at the same time through the actions of various secretions.

Food is first taken into the mouth and passes thence into the rumen, or first stomach, where it is subjected to a churning action.

In the mouth, the teeth play an important part by grinding up the food, a process called mastication. Saliva is produced by the salivary glands on the

sides of the mouth and under the tongue, and it is in this connection the advantage is had of feeding appetising foods, which produce a greater flow of saliva than unappetising foods. Food is first passed very imperfectly masticated into the rumen, from whence it is brought back into the mouth for further mastication, called rumination or "chewing the cud." The passage from the mouth to the rumen is called the œsophagus or gullet. During rumination more saliva is produced and poured over the food. The action of the saliva is to convert insoluble starches into soluble sugars. The rumen is very large, having a capacity of 50 to 60 gallons in an adult animal. After rumination the food again passes down the gullet through the reticulum into the omasum, any imperfectly masticated food being again retained in the rumen. The action of the digestive passages is quite involuntary after the food leaves the mouth, the food being passed on by the alternate contraction and expansion of the organs. In the omasum the food is subjected to heavy pressure and grinding between the "leaves," after which it passes on to the abomasum or true digestive stomach.

Here the gastric juices are poured upon the mass. These juices are acid, and convert proteids into peptones, and also contain rennet which, especially important in calves, commences the digestion of milk. At this stage the mass is called "chyme."

From the abomasum the food is passed through the pyloric orifice into the small intestines. The pylorus has the power of retaining such portions of the food as are insufficiently prepared. Intestinal juices, pancreatic juice, and bile are here poured over the mass.

These continue the chemical action of the previous secretions.

Bile assists in the digestion and prevents fermentation. Pancreatic juice acts upon the fatty matters and also continues the work of the saliva. The action of these juices produces further changes in the mass which is now called "chyle."

In the small intestine the assimilation of the nutrients into the system takes place. The walls of the intestines are coated with small projections called villi. This coat is called the villous coat. The nutriment is

taken into the system through the villi and mixed with the blood. The blood carries the nutriment through the liver for purification and then distributes it to every part of the body to repair waste tissues, provide heat and energy, and, in the case of cows, to produce milk. The food is only passed into the blood in solution, and the waste or indigestible matter is passed from the small to the large intestine, thence to the colon and rectum, and out of the body.

Milk is elaborated from the blood by the action of the mammary glands, and it is easy to judge from the foregoing, that, if the digestive organs are in any way impaired, or incapable of carrying out their functions, the milk yield must inevitably suffer.

The first essential for a good milch cow is that she should have abundant capacity for digestion and assimilation of food, otherwise the blood cannot carry nutriment to the mammary glands for milk production.

Question 2.—State what diseases calves are most subject to and how they may be prevented.

Answer.

The diseases to which calves are most subject are as follows :—

1. Scours (infective and indigestive).
2. Skin diseases (ringworm, mange, etc.).
3. Worms (hoose, intestinal)

The whole of these are preventible by care, and are, normally, the direct result of carelessness and filth.

Scours may be caused by want of care in treating the navel cord at birth. The cord should be carefully tied and treated antiseptically to prevent the entrance of bacteria, which are a frequent cause of this disease. Scours may also be caused by careless feeding. Stale milk, milk fed at an incorrect temperature, and milk from dirty vessels cause scours, but on the whole the most frequent cause is the turning of calves into a dirty pen with an imperfectly healed placentic cord. Another troublesome complaint, originating in neglect of the placentic cord, is an inflamed state of the navel known as "navel ill."

Skin diseases are usually of the parasitic variety. Ringworm and mange are very prevalent. Isolation of

the affected ones and strict cleanliness may be effective in preventing the spread, but carelessness will inevitably result in the whole of the calves becoming affected.

Hoose is caused by a small worm, the *Strongylus micrusus*, gaining access to the bronchial tubes, causing a troublesome cough which, if ignored, may develop into bronchitis.

Intestinal worms are troublesome and insidious enemies of calves Usually, the only indication of their presence is a falling off of the animal in condition, and failure to thrive. A dose of turpentine in oil or milk administered once a week, fasting, is a useful preventive. Calves should be specially prevented from grazing on damp pastures, more especially if there are indications that the land is "sour." The navel cord should be carefully tied and disinfected and wooden grids provided in calf pens to keep the calves from lying on a cold or damp floor.

The keynote to the successful rearing of calves is cleanliness. Clean food, clean pens, clean bedding, light, warmth, and good drainage will do much to eliminate disease from the calf pen.

Question 3.—Give a brief account of Hygiene on the Dairy Farm.

Answer.

See separate article on this subject, Vol IV, Part 1, by G. H. Frost.

Question 4.—Give six of the most serious parasitic diseases of cattle and state how you would prevent your herd from becoming affected.

Answer.

Parasitic diseases are those caused by vermes or worms, the protozoa, fungoids, and arthropoda.

The most serious are :—

1. *Piroplasmosis, or Texas Fever,* caused by the action of protozoa on the blood. It is spread by means of ticks and can only be prevented by the destruction of the ticks. It attacks imported cattle, while Indian cattle are not so susceptible.

2. *Enteritis,* caused by the presence of a minute worm in the intestines which causes inflammation.

3. *Ringworm,* caused by a fungoid growth on the skin.

4. *Actinomycosis,* caused by a fungoid growth, usually on the bones of the skull, causing lumpy jaw, wooden tongue, etc.

5. *Hoose* in calves. Caused by a thread worm, the *Strongylus micrusus,* gaining access to the bronchial tubes.

6. *Warbles,* caused by the larva of the bot-fly which burrows under the skin and deposits its eggs. (Not common in India.)

7. *Tapeworm,* which obtains ingress into the stomach and intestines.

8. *Mange,* caused by a burrowing parasite in the skin. This is spread by contact, and all animals must be carefully isolated.

The majority of the above are due to defective pastures, and some are spread by dogs, jackals, etc., which act as hosts for the parasite in some intermediate stage of its growth.

Draining and liming grazing grounds, and careful attention to grooming and surroundings, will usually check the operations of these pests.

Prevention, therefore, lies in draining grazing grounds, lime-washing and disinfecting cattle-sheds, calf pens, feeding and water troughs.

Supply pure water plentifully and prevent outside animals having access to the pastures. Wash and groom animals regularly. If ticks and other skin parasites are prevalent, the animals should be occasionally dipped in disinfecting solution.

Question 5.—State briefly what you know about Rinderpest and how to deal with an outbreak.

Answer.

See special article published elsewhere in this journal. By R. Osborne, N.D.D. (I.)

Question 6.—Give 12 of the most important carriers of disease.

Answer.

The most important carriers of disease are :—

1. Infected animals.
2. Human beings.
3. Food.
4. Fodder.
5. Water.
6. Milk.
7. Flies and other insects, and ticks.
8. Crows.
9. Deer.
10. Pigeons and fowls.
11. Dogs and cats.
12. Goats.

SECTION VII.—DAIRY TECHNOLOGY.

Possible Marks: 100. *Time Allowed:* 4 *hours.*

Question 1.—Give a brief outline of the method of making butter from the time the milk is separated to the storage of the butter.

Answer.

An article on "Butter-Making" by R. C. Woodford, N D D. (I.), appeared in Vol. IV, Part II, page 75.

Question 2.—What should be about the average over-run in butter. The amount of salt. The loss of fat in

(*a*) Separated milk.
(*b*) Butter milk.

Answer.

An article on "The Moisture Control of Butter" appears in Vol. IV, Part II, page 132.

The amount of salt in butter should average between $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent. The maximum quantity, *viz.*, $3\frac{1}{2}$ per cent., is generally used, but there is a loss in moisture which reduces it to about $2\frac{1}{2}$ per cent.

(*a*) Separated milk should not contain more than 0·01 per cent. of fat, but the machines would have to run under perfect conditions to obtain this result. It is possible to get such a low percentage of fat left

in the separated milk, and it should be the aim of the farmer to extract as much fat as possible.

Question 3.—Give a brief idea of how to test—

(*a*) Cream for fat.
(*b*) Butter for water.
(*c*) Cream for acidity.
(*d*) Separated milk for fat.

Answer.

A good article on "Simple Tests for Dairymen and Students" will be found in Vol. IV, Part II, pages 93 to 96, by R. Osborne, N.D.D. (I.)

Question 4.—Describe the best method of sterilising milk in bottles, showing the chief precautions necessary to attain success.

Answer.

The sterilisation of milk in bottles is generally carried out by means of a tank so constructed as to hold and maintain a steam pressure. It is fitted with steam and water connections for inlet and outlet pipes, steam pressure gauge, and a thermometer. The thermometer is screwed through a hole with a thread in the lid of the tank. The bottom end of the glass with mercury is long enough to go into a bottle or jar on the bed of the tank. The lid is fitted with screw clamps, and the bottom is fitted with a perforated plate on which the bottles stand.

Process of Sterilisation.—There are two methods of sterilisation, by live steam direct into the tank and on to the bottles, or by steam inducted through water in the tank.

The process is briefly explained here :—

The milk should be fresh milk, thoroughly cleaned by passing through the separator with the cream screw out, or by carefully straining through a filter fitted with cotton wool filtering medium. The bottles should be carefully sterilised and allowed to cool. The rubber rings of the stoppers should be removed and boiled, and then sterilised in the tank after washing, at the same time as the bottles are sterilised. These may be put together on a tin plate. The bottles should now be filled about two inches from the top, to allow for expansion of the milk under heat. They should then be put

into the tank close up together as vibration will cause them to break.

The jar, or bottle with the neck broken off to allow the thermometer to be inserted, to be used as a temperature gauge, should contain milk or water of the same temperature and quantity as the milk in the bottles. The test bottle should be placed under the thermometer hole in the lid, so that when the thermometer is screwed down the end will be in the test bottle.

The tank should be filled with cold water up to the shoulders of the bottles. If filled too high, the water, under steam pressure, will go into the bottles also. The quantity of water naturally increases with the condensation of steam.

Screw down the lid, adjust the thermometer. Turn the steam on slowly, close all water cocks, and gradually heat up the milk to 195 degrees Fahrenheit, which should take 35 minutes. Maintain the temperature by means of adjusting the steam inlet.

Now unscrew the thermometer, open up the tank, and allow the milk to cool down. This can be done by natural cooling or by gradually letting in cold water, and letting out the hot water.

This must be very carefully done, for the bottles are liable to be broken by a sudden reduction of temperature.

Having allowed the milk to cool for five hours, in order that the spores may again form, the second and final operation is carried out.

The stoppers are now put ready on the bottles with good new rubbers, ready to close, but not clamped down.

The water or milk in the test jar is tested to see that the temperature coincides with that of the water in the tank. Any difference can be adjusted by adding hot or cold water, as found necessary.

Turn on the steam gradually and see that all water connections are closed. Again heat up to 195 degrees Fahrenheit. Keep at that temperature for 20 minutes. Slacken steam but do not shut it off, unscrew the thermometer, lift it out, and with the help of assistants unscrew the lid and lift it off as quickly as possible.

The steam is still coming in, and there is a sterile vapour in the tank. Close down the stoppers using all speed.

The cold air coming in causes the stoppers to be sucked down, hence the air goes into the bottles if the operation is not done quickly. The lid should now be closed down, rubber gloves being used for the operation. Raise temperature to 195 degrees quickly and maintain for ten minutes. Remove lid and allow the bottles to naturally cool down in the tank.

Do not lift the bottles out until they are cold or they will break. Allow them to cool in the tank. After cooling for some hours they can be tested by turning upside down and giving the bottom a sharp rap with the fist. If the sterilisation is perfect a sharp metallic sound will be heard. If not, the sterilisation process has not been successful.

Question 5.—Give in detail methods for despatching milk long distances by train.

Answer.

An article on "Transport of Milk by Modern Methods" will be found in Vol. IV, Part I, pages 21 to 24, by "Maori."

Question 6.—How may the viscosity of cream be replaced after pasteurisation ?

Answer.

The viscosity of milk may be replaced after pasteurisation by the addition of a solution known as "viscogen." This is made in the following way :—Two and a half ounces of sugar are dissolved in five ounces of water. In a separate vessel one ounce of lime is dissolved in three ounces of water. The two liquids are then mixed, shaken up, and allowed to stand until clear. The top solution is then syphoned off, and is used as "viscogen." One part of this viscogen is placed in one hundred and fifty parts of cream.

REVIEWS.

"A Table of Relative Values of some Concentrated Cattle Foods." By O. T. Faulkner, B.A. (Cantab.). Reprinted from the *Agricultural Journal of India*, Vol. XII, Part I, January 1917. Thacker, Spink & Co., Calcutta.

This article gives some very interesting information, and deals with the concentrated foods available in India. It should prove very useful to agriculturists in India, as the want of such data has been greatly felt. In this country, the Home analyses are of little use to us; thus, Mr. Faulkner has done us a great service in giving us these tables of Indian analyses.

NEWS AND NOTES.

Shocked Milk.

New Electrical Treatment.

Have you ever heard of such a thing? Most likely not. Bewildering as the statement sounds, shocked milk will yet make many a mother's heart jump for joy. How? Why? Well, because it will be milk that we can give our children with the absolute certainty that in it no disease germ lurks, and if this is not good news for mothers, what is? "Shocked" milk is simply milk through which an electric charge has been passed, milk which has in effect received a shock that has destroyed any germ that may have got into it. It is the very newest and latest word in the attainment of that most-to-be-desired thing—pure milk.

It is the invention, not of a doctor, nor of an eminent scientific man, but of a member of the Liverpool City Council, who, eighteen years ago, was one of the first to make a public outcry on the subject of impure milk. He has invented an apparatus which sends an electric current through the milk, thus "electrocuting" every germ in it. And—this is most important—while absolutely freeing the milk from danger, the "shock" leaves the milk itself quite uninjured. This cannot be said for any other method by which milk is made germ-free. Sterilising is a mischievous process and responsible for many a case of rickets, because during the process the lime salts are to a considerable extent precipitated. Sterilised milk is therefore largely robbed of its lime, and lime is one of the most important things or making bone.

Effects of Boiling.

"Pure milk," says a well-known German professor, "contains more lime than lime water." Thorough boiling will kill germs in milk, but at the same time it alters the milk greatly. The "skin" that forms on the top of boiled milk, and which children can rarely be induced to swallow, is the coagulated albumen of the milk. Now the albumen is an extremely valuable part of milk—it is much the same as white of egg—and is the chief flesh-forming material in both eggs and milk. When milk is subjected to a high degree of heat it is therefore deprived of a good share of the properties that make it so valuable as a food for young children. They are growing fast, and need nourishment that will make strong bone and firm flesh. Milk makes these two things better than anything else—if it is fresh, pure, and uncooked. All these processes—sterilising, boiling, etc.—have come into vogue because we now know that milk is about the most favourable soil that disease seeds of every kind can find to flourish in.

"I once met with a bacterium, but only once, that would not live in milk," said the late Lord Lister, England's greatest bacteriologist, "for," he adds, "extremely numerous as the varieties of bacteria are, almost all of them seem to thrive in that liquid."

***

Tuberculous Cows.

One of the most terrible germs, that of tuberculosis from which consumption springs, is largely spread by drinking the milk of tuberculous cows. In this country there are five million cows affected with tuberculosis. Most of these are giving milk for a long time before the disease kills them. When we buy a glass of milk we have not the slightest idea whether it comes from a tubercular cow or not. It is said that one of the best-known specialists on tuberculosis in England absolutely refuses to drink a glass of milk. He knows too much to do so with a quiet mind. And, besides tuberculosis, the germs of scarlet fever, summer diarrhœa, typhoid,

and diphtheria breed rapidly in milk. Many an epidemic of these diseases has been started by one single case in a farm or dairy, which has been spread broadcast in the milk coming from that place.

The apparatus for "shocking" milk is only just coming into use in Liverpool. It has been tried and tested during the last eighteen months in Liverpool University. That it will be soon in general use all over the country there can be little doubt. What it will do for the rising generation we, who have deplored the dangers that lurk in the milk, can look forward to with confidence and thankfulness.

***

The Value of Lime.

Lime, as a help in maintaining fertility of the soil, has now come to be regarded as an important factor in agriculture. Some soils would be benefited more by the application of lime than by the application of commercial fertilizers.

To most of our cultivated trees and plants a sour soil is distasteful. Some of the more common agricultural plants which are injured by an acid condition of the soil are spinach, lettuce, beets, celery, onion, parsnip, cauliflower, cucumber, egg plant, cantaloupe, pumpkin, asparagus, cabbage, pepper, pea, tobacco, lucerne, clover, barley, wheat, oats, timothy, and Kentucky blue grass. Clover and timothy—two most important crops—are quite sensitive to acidity in the soil. There are countless experiences where clover "did not stand well" or "failed to catch" or was "winter killed," until the land was limed. In many sections, clover is regarded as the key-plant to the maintenance of fertility. That soil which has clover in its rotation is not likely to become "worn out." There is a vital connection between a good stand of clover and an abundance of lime in the soil. Lucerne, which is a very important crop, is also greatly benefited by lime. The root bacteria which are essential to its growth cannot thrive in sour soil. Of the grains, barley appears to be the most impatient of an acid soil, followed closely by wheat and oats. Indian

corn and rye are able to succeed much better upon a sour soil than the other cereals. On the other hand, there are a few plants which seem to prefer a sour soil. Those on record are serradella, water-melon, blue lupine, golden millet, Hungarian grass, and red-top.

Fruit trees do not thrive in sour or badly drained soils. Lime is beneficial in freeing the plant foods and making them available for absorption into the root system.

A soil may become sour by the treatment it is given. The use of "cover crops" and "green manures," which are crops grown for the purpose of being ploughed under to enrich the soil with humus, is becoming a common and very profitable practice in modern agriculture. But, if an excessive amount of this material is added to the soil, and especially if a very large crop of it is ploughed under, the effect sometimes is to make the soil slightly acid, through the fermentation and decay of such a large mass of green plants. Hence it is an excellent practice to apply lime to the soil whenever a green manure crop is added to it. The sourness of soils is sometimes increased by the use of certain manures and fertilisers. Nearly all fertilisers containing the plant food nitrogen, except nitrate of soda, however, make even more acid a soil which tends to be sour. Acid phosphate, superphosphate, dissolved bone, and bone-black, all of which contain acid, have the same tendency.

It must not be inferred that if a soil is found to be sour that these fertilisers should not be used upon it. The point is that lime is usually more necessary if these fertilisers are used than if not. Continue to use them, if necessary, but offset their injurious effect by an occasional liming of the soil.

The soil that needs lime most is the sort that is "sour." There are countless acres of soils in this country, including a large percentage of farm and garden lands, which are more or less sour.

Undoubtedly many soils now produce poor crops, not because they are "worn out," "but because they are acid or sour," and most crops do not thrive in sour soil. Many different kinds of soil may become so acid that some crops grow poorly in them.

It is not only peaty, mucky, and other swamp and marsh lands that are liable to be sour. These soils are frequently very acid, owing to the large amount of decaying vegetation which they contain, but soils that are full of this decaying vegetation are not as commonly sour as upland soils, which are usually lacking in this material. Some of the most acid soils are the light sandy loams which are formed from rock that was probably deficient in lime.

So, the nature of the soil is no trustworthy guide as to whether it is acid or not. The only sure way of determining this point is to test the soil, and it is a cheap and easy way.

Lime is, moreover, an actual plant food. If a soil contained no lime whatever, plants could not grow upon it. We call nitrogen, potash, and phosphoric acid the "essential" plant foods only because they are more likely to become exhausted in ordinary soils than lime or any of the other foods which plants must have. It is true that most soils do not need to have lime applied to them as frequently and as liberally as fertilisers which contain these other three plant foods. There are some soils, however, that become exhausted of lime, just as other soils become exhausted of potash or phosphoric acid. Lime is then needed for its value as a plant food, instead of, or in addition to, its value in other ways. It is often wise to dress cultivated land with lime every three or four years.

Lime has striking effects on certain soils; making a sandy, leachy one retentive of water; and turning heavy soils into a workable, friable condition.—*The Fruit World.*

***

The Age of Horses.

Their Story as Told by the Teeth.

One of the things that every young farmer ought to learn is the "ageing" of horses, or the ascertaining of their age by the teeth, says *The Farmer and Stock-breeder.*

The foal is born with two front teeth breaking through or partly above the gum, and one on either side

is either feelable or showing a mark where it will be through in a few days. At two months he has four front teeth showing in the lower jaw, where we all look for age. In six or eight weeks the second pair (laterals) as well as the temporary grinders (molars) are well up. But the size of the foal and the appearance of his mane and tail, and the time of year and the presence of his dam, and his dependence upon her, will prevent any serious miscalculation as to age. It is later on that mistakes occur.

A yearling or colt between one and two years old, with all his teeth and well furnished, has often been mistaken for a five-year-old, and this seemingly ridiculous error happens most frequently in the case of forest ponies, who soon lose their appearance of youth in outward general conformation. Still, two-year-olds with a complete set of baby teeth have been sold as five, so that the reader will see that the idea is not so extravagant as it might at first sight seem.

Appearance of Permanent Nippers.

There is a convenient, but not absolutely accurate, way of remembering the ages at which the permanent nippers come. It is given in a sentence as follows: $2\frac{1}{2}$, $3\frac{1}{2}$, $4\frac{1}{2}$. At about $2\frac{1}{2}$ years, that is to say in the autumn (reckoning by English time), or somewhere before Christmas in a May foal, the first or central pair are clearly through the gums, or about halfway up. He is then said to be "rising" three years old. By the following spring or foaling time these two teeth are up to the top and meeting those in the upper jaw. They are so much larger than the two milk teeth on either side of them as clearly to mark him as a three-year-old. In the following autumn a tooth is cut on either side of the two central ones, now mature. He is then rising four years old. By the first of May he will have four out of six permanent teeth meeting those of the upper jaw, while the temporary or milk teeth at either end remain, looking much smaller and whiter than the four permanent ones. Now comes the period in which so many persons are deceived, although the matter is capable of the simplest explanation. The shedding of the corner

temporary or milk teeth is often promoted by sellers by drawing them when the fang is nearly absorbed. It is often said that very little is gained by the act, but there is a gain of a few weeks. The last permanent tooth is said to be breaking the gum in May or June in a foal dropped in March or April, and when once this tooth is showing the dealer calls him five years old. He is not five years. He is four years "off" until October, when he will be "rising" five years. The writer has been examining some thousands of mouths during the past year, and met with masters of hounds even who have been always under the impression that as soon as a horse cuts his corner tooth he is five years old. It is not so. He will not be five years old until the following May (or other month he was born in). He is not five years old until the upper and lower corner teeth meet over their whole surface (table), and the front edge has begun to show wear, while a fine rim at the back has begun to appear through the attrition which eventually wears down all the teeth of horses. We have said 2½, 3½, 4½, and so it is, for the four-year-old corner tooth is not practically level with its fellow in the upper jaw until he is fully 4½ years, and is still shelly or imperfectly developed until approaching five years old in the spring, when the changes previously mentioned may be noted on the front and back edges. "He has a full mouth," the dealer will say, and must be five years old. He is not five years old until his corner teeth are fully developed.

Another opportunity must be taken to deal with ages, but let it be said here that thorough-breds date from January 1 and all other horses' birthdays are reckoned from May 1. Some are foaled early in March and others in July, and of these extremes we have to take account, but for general purposes we may keep to the established custom.

Between May and October a horse is so many years "off," and from October to May 1 he is so many years "rising." It is important to keep this division of the year in mind, because of the universal error fostered by sellers of describing a horse as "rising" five when he is but just turned four.—*The Producers' Review*

Silage Burns in Silo.

I had 26 feet of silage in my silo and fed 12 feet which was nice. When I came down 4 feet above the ground it became hot, and about half way in the silo from the chute it is burnt but is not moldy. Would you advise me to put water on it? Is it safe to feed the burnt silage to the cows? Half of the silage is all right.

New Holstein, Wis. G. T.

We have had several inquiries of a similar character, some reporting burnt silage and others that the silage heats and molds in the center after the removal of several feet of good silage. We have been unable as yet to offer a satisfactory explanation or solution of the trouble or to give any method of handling silage in this condition that will overcome the further heating and spoilage. We ask our readers who have had this trouble to write us and give us their experience with any control methods they have adopted.

It is possible that the exercise of care in not breaking the silage surface deeper than necessary to get each feed, and keeping the surface level, and possibly covered with canvas, will be of some value; also, the application of water may be desirable and is worthy of a trial.

The moldy silage should, of course, not be fed, but the burnt silage is not likely to adversely affect the health of the animals.—*Hoards Dairyman.*

* * *

Spontaneous Combustion of Silage?

During the past week, two of our farmers in the vicinity of Mishicot had their barn destroyed by fire. The general opinion in the neighbourhood is that these farms were destroyed by fire caused by spontaneous combustion from the silo. One farm contained a concrete silo. However, there was a crack in the silo. The other farm contained a wood silo and both of the silos were inside of the barn.

I have noticed that in districts where the soil was somewhat light, that the corn started to dry up and undoubtedly when these farmers ensiled their corn, the same was placed in the silo in a rather dry condition or contained just enough moisture to cause spontaneous combustion.

Manitowoc, Wis.

J. L.

Although it may be somewhat dangerous to venture an opinion, yet we very much doubt whether the fires were actually due to spontaneous combustion. We apprehend that further investigation will disclose some other cause. We have never observed silage that showed an indication of being charred or having started to burn, but it is possible that with light and loose material there may be sufficient entrapped air to permit combustion if enough heat is generated. It would have been desirable to have added water during the filling process and to let the cut bundles lie on the damp ground overnight.

What has been the experience and observation of our readers ?—*Hoards Dairyman.*

***

To Ensure Clean Milk.

A method of inspecting dairies and cowsheds has been introduced from America, which is called "the card system," for convenience, and which consists in awarding points according to a scale on a card, where 100 is taken as the maximum. Such things as air space, ventilation, drainage, freedom of animals from disease, proof of tuberculin testing, grooming, etc., etc., are all noted and assessed at proportionate marks. A farm that gains over 50 per cent. would "pass," while a really good subject might gain over 80 per cent. A scientist in New York has been examining the milk from a large number of farms in that State which had been inspected and their card values made out, and he has made the disconcerting discovery that the dairies that won the highest marks were producing the worst contaminated

milks, and the worst dairies had the best milks. By "contamination" is meant, of course, the presence of the greatest number of bacteria in a cubic centimetre of milk in the usual method of making a "bacterial count," without reference to the species of bacteria. All the same, discoveries like this tend to knock the bottom out of the sanitary ideas of our authorities; as an American paper puts it: "It is a joke on fussy dairy authorities." It is to be hoped that the Clean Milk Society will take note of this: they have been advocating the use of score cards in this country, but if this is the outcome, then the frightful expense our authorities are putting dairy farmers to is quite uncalled for.—*The Dairy.*

*
* *

Rotation of Crops.

The subject of "farm management," as it applies to the rotation of crops, receives very careful and thorough attention in several of the States of North America. In Minnesota, trials have been proceeding since 1895 to ascertain what is the most profitable way of working farm lands, regard being had to all the conditions and surrounding circumstances in making the decision.

As illustrating the importance of the matter in the view of these advanced agriculturists, it may be mentioned that it is taught as a distinct subject in at least one of their agricultural colleges.

The United States Department of Agriculture, in conjunction with the Minnesota Agricultural Experiment Station, has issued a bulletin entitled "Farm Management," which gives the results of the trials of different crop rotations in Minnesota, carried on during the period 1895 to 1909, with the net profits per acre. Much of the data will not apply to our conditions, but the following general conclusions should be valuable to farmers designing rotations of crops in different districts:—

(1) Cultivated crops, as corn, potatoes, and mangels, grown continuously, rapidly decrease the productivity of soils. This is largely due to the fact that cultivation stimulates decomposition of vegetable matter,

leaving too small a supply of fresh vegetable matter in the soil.

(2) Grain crops grown continuously decrease the productivity of soils. This is believed to be due partly to reduction of fresh vegetable matter, and partly to increase in weeds.

(3) A rotation of corn, oats, millet, and barley, which tend to exhaust the vegetable matter, did not produce better results than continuous wheat cropping.

(4) A two-year rotation of mangels and wheat, both of which reduce vegetable matter, gave little better yields of wheat than wheat continuously.

(5) A two-year rotation of wheat and annual pasture gave greatly increased yields of wheat, because the annual pasture crop added fresh vegetable matter to the soil.

(6) A three-year rotation of corn, wheat, and clover, with no manure, did not give as large yields of corn and wheat as were obtained from a five-year "standard" rotation of corn, wheat, meadow, pasture, and oats, with some manure applied to the corn. Clover once in three years did not maintain the supply of fresh vegetable matter so fully as the five-year rotation with two grass crops and eight tons of manure once every five years.

Of course the "standard" rotation mentioned would not apply to the conditions throughout New South Wales; but the authorities quoted show the great necessity in any rotation of providing for a continuous supply of fresh vegetable matter in the soil. Continuous cropping with grain, including rotation of small grains with corn, reduces the vegetable matter in the soil.—*The Producers' Review.*

* * *

Green Manuring.

The object of green manuring is to add nitrogen and humus to the soil. This is brought about by ploughing in either the first, second, or third growth of some plant of the leguminous kind, such as clover, vetches, lupines, peas, beans, and lucerne. Another way is to utilise the whole of the green fodder, either as ensilage,

hay, direct feeding or pasture, and being satisfied with the stubble roots only to enrich the soil. But it has been found by practical farmers in South Australia, where some, though only a few, have adopted green manuring, that ploughing in the green stuff is much better, as the resulting benefits from the gain of nitrogen and humus are so much greater.

Farmers in the State just named complain that the soil is becoming much harder to work, preventing them from putting in as much wheat as formerly. Others again, in districts where light, sandy soils prevail, complain that after a few dry days the soil is drifting and yielding to the pressure of the wind. Green manuring will overcome this difficulty as well as prove a safeguard against the farmer's greatest enemy—the drought. Other advantages of green manuring are that, besides enriching the soil with humus, it binds light soils, and empowers them to retain moisture. In heavy soils they are made more pliable and loose, and the nutritious elements are more readily absorbed. It unlocks the mineral matters located at greater depths; it improves the physical condition of the soil; it promotes valuable fermentation in the soil, and rids the land of weeds. It is a complete substitute for stable manure, incomparably cheaper, and its effect on succeeding crops are remarkable, and noticeable up to four years after. A practical farmer, who has tried the system, says that if a man green-manures one-fourth of his cultivation area each year, he will, at the end of the fourth season, have as perfect a tilth as practice can produce, rich in everything that is required to produce healthy growth. One of the great advantages of the system of green manuring is that the manuring matter is produced on the spot, partly from the soil and partly from the rain and atmosphere, and the expense of purchasing artificial manures is entirely avoided.—*The Producers' Review.*

***

Feeding cotton-seed meal and hulls to dairy cows: J. S. Moore (Mississippi Sta. Bul. 174 (1914). pp. 1—10).—In an experiment which lasted over six years, nine cows in their first lactation period were

divided into three lots of three cows each; later on two heifers were added to each lot. Lot 1 received a heavy ration of cotton-seed meal with little other grain feed and no cotton-seed hulls for roughage; lot 2 received a heavy ration of cotton-seed hulls with no cotton-seed meal; and lot 3 received no cotton-seed products. During the greater part of the first period (180 weeks) the cows were fed the maximum amounts of cotton-seed meal and cotton-seed hulls, and during the second period (144 weeks) they were fed these amounts only when giving a fair yield of milk and when pasture was not available. As a rule, during the second period little cotton-seed meal was fed for 30 days before calving and no cotton-seed meal for a time after calving.

The cows in lot 1 were bred 56 times and dropped 22 calves, with an average of 14 months between calvings; the cows in lot 2 were bred 41 times and dropped 24 calves, with an average of 13 months between calving; and the cows in lot 3 were bred 29 times and dropped 24 calves, with an average of 12 months between calvings. The average daily production per cow during the first period was for lot 1, 13·7 lbs. of milk and 0·6 lq. fat; lot 2, 14·3 lbs. of milk and 0·6 lb. of fat; and lot 3, 11·7 lbs. of milk and 0·5 lb. of fat; and during the second period, lot 1, 10 lbs of milk and 0·45 lb. of fat; lot 2, 12·5 lbs. of milk and 0·54 lb. of fat; and lot 3, 11·9 lbs. of milk and 0·56 lb. fat. Abnormal conditions, if any, occurring in the case of each animal are noted.

69107°—No. 9—17——6.

"Results indicate that the feeding of 5 lbs. of cotton-seed meal for any length of time is injurious to the dairy cow, causing inflammation of the udder, difficult breeding, and probably having a tendency to cause retention of afterbirth. Feeding cotton-seed hulls in the quantities given appears to cause difficult breeding, though not to the same extent as the feeding of cotton-seed meal. In the above test it has been clearly shown that bad effects may follow the use of cotton-seed meal in too large amount."

Progressive oxidation of cold-storage butter: D. C. Dyer. (U. S. Dept. Agr., Jour. Agr. Research, 6

(1916), No. 24, pp. 927—952, pl. 1, fig. 1).—In preliminary the author summarizes the investigations as follows:—"The development of undesirable flavors in butter held in cold storage at a temperature of 0° is not dependent upon an oxidation of the fat itself. The production of 'off-flavors' so commonly met with in cold-storage butter is attributable to a chemical change expressed through a slow oxidation progressing in some one or more of the non-fatty substances occurring in the butter-milk. The extent of this chemical change is directly proportional to the quantity of acid present in the cream from which the butter was prepared. The quantity of carbon dioxide present in cold-storage butter appears to have a certain relation to the quantity of buttermilk in the butter. During storage this quantity of carbon dioxide may increase to a maximum followed by a progressive decrease."

Does it pay to take extra care of cows? C. C. Hayden. (Mo. Bul. Ohio Sta., 1 (1916), No. 8, pp. 245—248, figs. 2.)—Two cows of the station herd were put under official test conditions for one year. As compared with their previous treatment they were given better care and extra feed, and for a part of the year they were milked three times daily. Under these conditions the first cow, during her fifth lactation period, produced 14,722 lbs. of milk and 400 lbs. of fat, whereas her average production during the first four lactation periods was 8,194 lbs. of milk and 239 lbs. of fat. The production of the other cow, during the test, which was her sixth lactation period, was 15,318 lbs. of milk and 505 lbs. of fat, whereas her average production during the first five lactation periods was 8,195 lbs. of milk and 280 lbs. of fat. In these records, one year from the birth of each calf was taken as the lactation period.

The importance of vitamins in relation to nutrition in health and disease, C. Voegetlin (*Jour. Wash. Acad. Sci.*, 6 (1916), *No.* 16, *pp.* 575—595).—In this lecture the author outlines briefly recent advances in the science of nutrition, especially with reference to the importance of the presence in the diet of small quantities of substances essential for the maintenance of health. The subjects considered are the deficiency disease, beri-beri, the isolation and chemical properties of vitamins; the

physiological action of vitamins; and the distribution of vitamins in foods. A discussion of the factors which tend to reduce the vitamin content of the diet is included.—From *Experiment Station Record.*

*
* *

Calves and Milk Substitutes.

The Midland Agricultural and Dairy College, Kingston, Derby, has issued a leaflet giving the results of an experiment in calf-feeding with milk substitutes. On many farms, the report states, notably on milk-selling and cheese-making farms, no separated milk is available, and if calves are to be reared economically a complete milk substitute is necessary. In this case the farmer may either use a proprietary calf meal or make up his own. With regard to home-made calf meals, those recommended in various publications (*e.g.*, in Leaflet No. 142 of the Board of Agriculture and Fisheries) are too complex in composition, and require too much time and trouble in preparation to be popular. Accordingly the aim in these experiments was to find a ration that would fulfil the following conditions:—

1. Form a satisfactory substitute for milk when fed with water only.
2. Consist of ingredients readily obtainable by farmers at reasonable prices.
3. Require little time and trouble to prepare and to feed to the calves.
4. Reduce the cost of rearing as much as possible.

The Woburn ration of separated milk and crushed oats was taken as the standard, and compared with (*a*) water and mixture composed of linseed cake (finely nutted) 1 part by weight, wheat germ meal 1¼ part, dried yeast ¼ part, the whole costing 9*s.* 3*d.* per cwt: (*b*) Water and mixture composed of linseed cake (finely nutted) 1 part, bean meal 1¼ part, costing 12*s.* per cwt. A mixture composed of soya bean cake 1 part, fine sharps (middlings) 1 part, and crushed oats 1 part, was used at first instead of (*b*), but was found to be unsatisfactory.

The experiment was started in April, 1915. Twelve cross-bred calves, all under one week old, were obtained

DAIRY EDUCATION ASSOCIATION.

————————————*191* .

THE HON. SECRETARY,

DAIRY EDUCATION ASSOCIATION,

(INDIAN BRANCH),

85, *Survey Road,*

QUETTA.

Dear Sir,

I wish to become a member of the above Association, and if elected agree to promote the welfare of the Association to the best of my ability and to remain liable for my subscription until I shall notify the Hon. Secretary of my resignation. On receipt of your letter advising me of my enrolment as a member, I will forward the subscription of Rs. 5 to the Hon. Secretary (Mr. H. J. Riddick, 85, *Survey Road, Quetta), and yearly on October 1st, or otherwise accept the 1st issue of the Journal by V.-P. P.*

Dairy School or Schools attended and length of time of instruction.

....

....

Dairying Certificate, Diplomas, etc.

....

....

(Signed)..

Mr., Mrs., or Miss, etc.

Permanent Address...

....

All correspondence regarding the Journal, advertisements, etc., should be sent to the Hon. Secretary, Dairy Education Association, 85, Survey Road, Quetta.

This Journal is issued Quarterly—in October, January, April, July.

RATES OF SUBSCRIPTION.

Membership to Association, including subscription to the Journal	...	Rs. 5-0-0
Single Copy, including postage	...	Re. 1-0-0

ADVERTISEMENTS.

			Annual.	One issue
Full	page	...	Rs. 20-0-0	Rs. 6-0-0
Half	,,	...	,, 13-8-0	,, 4-0-0
Quarter	,,	...	,, 7-0-0	,, 2-0-0
6 Lines	...	...	,, 3-0-0	Re. 1-0-0

SUB-COMMITTEE FOR INDIA.

CHAIRMAN.

Dr. Harold Mann, D.SC., M.SC., F.I.C., K. H. Gold Medallist,
Principal, Agricultural College, Poona. and Agricultural Chemist to Government of Bombay.

MEMBERS.

William Smith, Esq.,
Assistant Director of Government Dairy Farms, Southern Circle, Poona.

D. Clouston, Esq., M.A., B.SC.,
Deputy Director of Agriculture, Nagpur.

H. J. Riddick, Esq. (Hon. Secy.),
Manager, Government Dairy Farms, 4th (Quetta) Division.

Edwd. Keventer, Esq.,
Proprietor of Dairy Farms, Aligarh, Simla, etc.

W. Reeves, Esq.,
Indian Dairy Supply Coy., Ltd., Bombay, Nadiad, etc.

R. Osborne, Esq., N.D.D. (I.),
Manager, Government Central Creamery, Ahmedabad.

Captn. G. H. Frost,
Asst. Director of Dairy Farms, Govt. Dairies, India.